



# SERVICE MANUAL

MERCURY  
TILT CAB

A.E.C. LIMITED SOUTHALL MIDDLESEX ENGLAND

APSA 2878 174.

(127)

# SERVICE MANUAL

FOR

## “MERCURY”

### GOODS CHASSIS

AEC LIMITED

SOUTHALL, MIDDLESEX, ENGLAND

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**All references to left-hand or right-hand in this Service Manual mean from the driver's viewpoint when seated behind the controls.**

## FOREWORD

**F**ORMING part of the AEC after-sales service, this Service Manual has been planned with two main purposes in mind. The first is to enable operators to obtain the longest working life from their vehicles with least idle time spent on maintenance and reconditioning. The second intention is to impart information of a practical nature to personnel responsible for driving and maintaining the vehicles and to this end the book should be made readily available to all such personnel.

The first part of this Manual incorporates information for the guidance of personnel responsible for the handling and day-to-day requirements of the vehicle.

Care has been taken to write the information plainly and concisely; much thought has been spent on the illustrations.

It will readily be understood that the instructions and methods set out in the book are based upon our experience as constructors. Many operators, however, will have methods of their own for solving specific problems; we shall welcome suggestions from them for increasing the practical value of the manual or criticism of its contents.

Apart from certain essential adjustments and the periodical routine maintenance recommended, a vehicle that is performing satisfactorily should not be tampered with. A necessary adjustment, however, should never be neglected and should receive attention immediately.

For practical assistance and advice, operators are invited to consult one of the many AEC Depots or Agents; a list of these addresses may be obtained on request.

The "Spare Parts Catalogue" which is a separate publication, is also available. In this respect the AEC Service scheme of exchange units has been organized to facilitate replacements and repairs.

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**Warning.—** If welding or soldering is necessary in the vicinity of the alternator or control unit, disconnect the cables from the battery; precautions must also be taken to ensure that heat is NOT transmitted to any transistor or diode, otherwise irreparable damage will be caused to the unit.

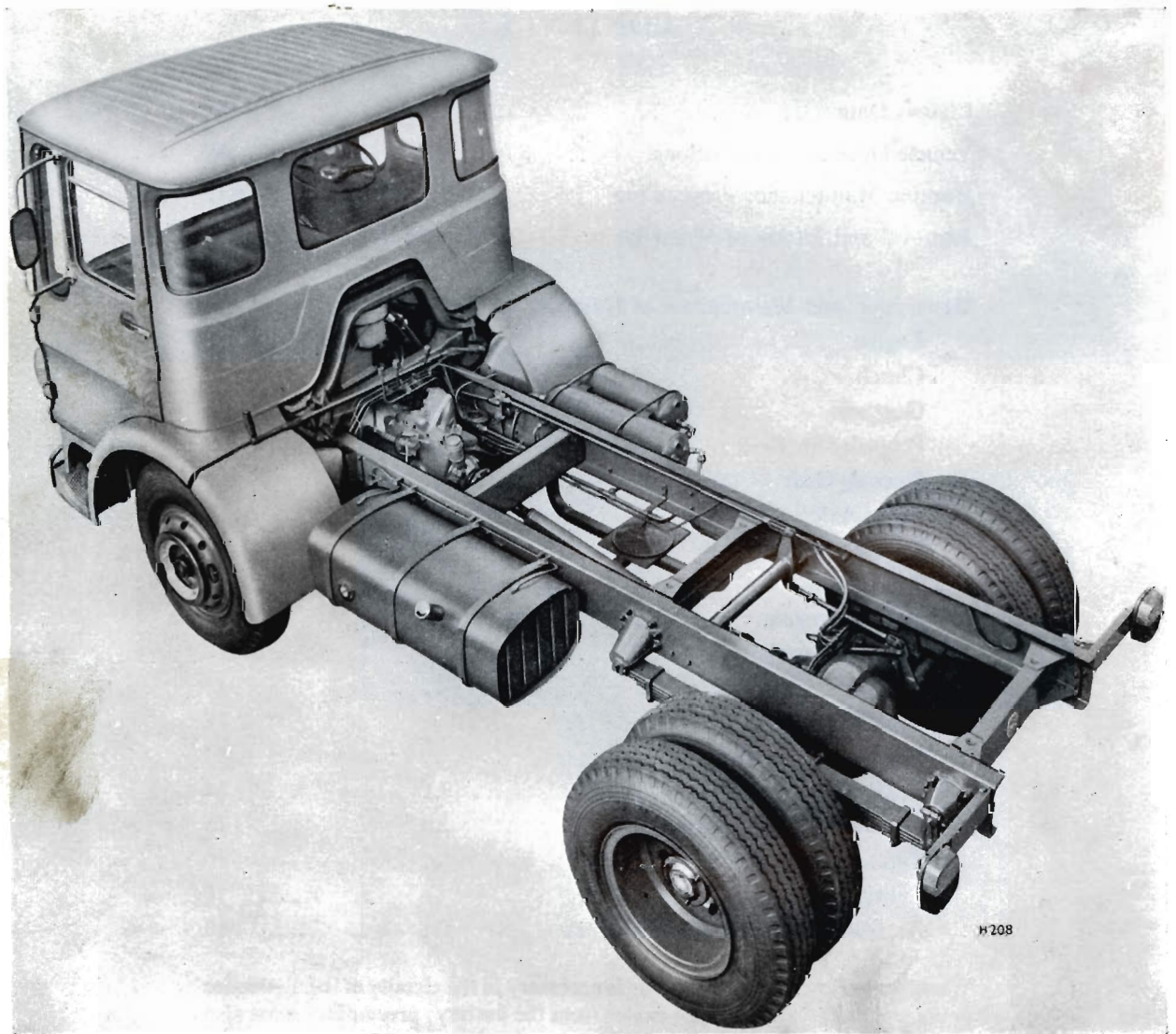


Fig. A1 Three-quarter view of typical chassis

## CHASSIS DATA

Unit and equipment type numbers given are abridged and do not cover minor differences. All communications concerning units should quote the full and exact type numbers with suffix as stamped on the unit.

Certain units on these chassis incorporate the Unified thread and hexagon system; these can be identified by the accepted British Standard Institution markings.

### CHASSIS

	Load Carrier	Tipper	Tractor	Passenger
Type Number .. .. .	<div> <div>TGM4R</div> <div>TGM4L</div> <div>TGM4RE</div> </div>	<div> <div>TGM4R</div> </div>	<div> <div>TGM4R</div> <div>TGM4RE</div> </div>	<div> <div>4M4R</div> <div>4M4L</div> </div>
Approximate weight (chassis only) for lifting purposes .. .. .	5 tons (5,080 kg.).			

### Principal Dimensions:—

	Wheelbase	Length (overall)	Turning Circles
Load Carrier or Tipper	10 ft. 9 in. (3,276 mm.)	18 ft. 6½ in. (5,651 mm.)	50 ft. (15.2 m.)
Load Carrier .. .. .	12 ft. 1 in. (3,683 mm.)	20 ft. 5½ in. (6,235 mm.)	53 ft. (16 m.)
	15 ft. 0 in. (4,572 mm.)	24 ft. 4½ in. (7,429 mm.)	62 ft. (18.9 m.)
	18 ft. 0 in. (5,486 mm.)	28 ft. 6½ in. (8,699 mm.)	74 ft. (22.5 m.)
Tractor .. .. .	9 ft. 6 in. (2,895 mm.)	16 ft. 5 in. (5,004 mm.)	41 ft. (12.6 m.)
Passenger .. .. .	16 ft. 6 in. (5,029 mm.)	30 ft. 0½ in. (9,157 mm.)	70 ft. (21.3 m.)
	21 ft. 6 in. (6,553 mm.)	35 ft. 10½ in. (10,935 mm.)	90 ft. (27.4 m.)

### Common Dimensions:—

Nominal Overall Width .. .. . 8 ft. 0 in. (2,438 mm.).

#### Track at Wheel Centres:—

	Tractor	Load Carrier
Front Axle .. .. .	6 ft. 4 in. (1,930 mm.) on 9.00-20 tyres. *6 ft. 3⅝ in. (1,913 mm.) on 10.00-20 tyres.	6 ft. 8⅜ in. (2,037 mm.) on 10.00-20 tyres.
Rear Axle .. .. .	5 ft. 11⅝ in. (1,819 mm.)	5 ft. 11⅝ in. (1,819 mm.).

\*Also applicable to Tipper and Passenger Chassis.

Ground Clearance (under rear axle) ..	Tyre Size	Clearance
	9.00-20.	9¼ in. (235 mm.).
	10.00-20.	9¾ in. (247 mm.).
	11.00-20.	10¼ in. (260 mm.).

### ENGINE (see also Part B)

Type Numbers	Nominal Dimensions	Cubic Capacity
AV471 .. .. .	112 mm. (4.41 in.) bore × 130 mm. (5.12 in.) stroke.	469 cu. in. (7,685 c.c.)
or		
AV505 .. .. .	116 mm. (4.57 in.) bore × 130 mm. (5.12 in.) stroke.	502 cu. in. (8,226 c.c.).

### Common to both types:—

Water Capacity (including radiator) ..	5½ gallons (25 litres) approx.
Approximate Weight (for lifting purposes only) .. .. .	1,365 lb. (619 kg.).
Number of Cylinders .. .. .	6.
Firing Order .. .. .	1, 5, 3, 6, 2, 4 (numbers from fan end).
Compression Ratio .. .. .	16 : 1.
Combustion Chamber .. .. .	Direct injection; toroidal cavity pistons.

**ENGINE** (*continued*)

Valves .. .. .	Overhead poppet, masked inlet.
Valve Tappet Clearance .. .. .	See Section 1.
Timing Gear and Auxiliaries .. .. .	Helical gear drive.
Water Pump .. .. .	Centrifugal.
Lubrication System .. .. .	Wet sump, gear type pressure pump.
Oil Capacity .. .. .	See under "Lubricant Capacity of Main Units".
Oil Pressure .. .. .	30 lb. per sq. in. (2.1 kg. per sq. cm.) <b>minimum</b> at engine speed of 1,800 r.p.m. <b>hot</b> .

For further information see Part B.

**CLUTCH**

Type .. .. .	Single dry plate, hydraulically operated.
Diameter of Driven Plate .. .. .	15 $\frac{3}{8}$ in. (390.5 mm.).
Area of Friction Surfaces .. .. .	237 sq. in. (1,529 sq. cm.).

**GEARBOX**

Type .. .. .	Constant mesh except for sliding mesh first and reverse speeds.
Number of Speeds Forward .. .. .	6.
First Speed Ratio .. .. .	6.63 : 1.
Second Speed Ratio .. .. .	4.44 : 1.
Third Speed Ratio .. .. .	2.54 : 1.
Fourth Speed Ratio .. .. .	1.53 : 1.
Fifth (Top) Speed Ratio .. .. .	1.00 : 1.
Sixth (overdrive) Speed Ratio .. .. .	0.75 : 1.
Reverse Speed Ratio .. .. .	6.59 : 1.

**Power Take-off Unit Ratio (when fitted)**

Normal Duty Unit .. .. .	1.31 $\times$ Engine speed.
Full Torque Unit .. .. .	1.28 $\times$ Engine speed.

**PROPELLER SHAFTS**

Type .. .. .	Tubular, with universal joints.
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**STEERING GEAR**

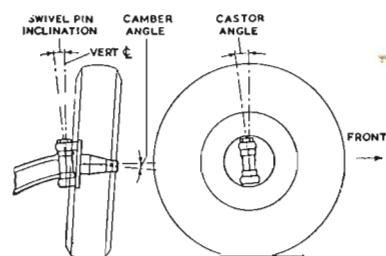
Type .. .. .	Recirculatory ball worm and nut.
Ratio (manual steering) .. .. .	35.2 : 1 or 6 $\frac{3}{4}$ turns from lock to lock.
„ (power assisted) .. .. .	27.5 : 1 or 5 $\frac{1}{4}$ turns from lock to lock.
Worm .. .. .	Single start right-hand thread.

**Power Assistance (when fitted)**

Type .. .. .	Hydraulic.
Hydraulic Pump (engine mounted):—	
Type .. .. .	Hoburn-Eaton [with 0.7 in. (17.8 mm.) dia. roller].
Hydraulic Double Acting Ram:—	
Type .. .. .	Hydrosteer.
Stroke .. .. .	13 $\frac{7}{16}$ in. (341.2 mm.).

**FRONT AXLE**

Type .. .. .	Reversed Elliot.
Camber Angle .. .. .	1 $\frac{1}{2}$ °.
Castor Angle .. .. .	1 $\frac{3}{4}$ °.
Swivel Pin Inclination .. .. .	6°.
Wheel Alignment .. .. .	Parallel.



\*Also applicable to 4M4R/L chassis.

**REAR AXLE**

Type .. .. .	Single reduction spiral bevel.
Ratio .. .. .	5.87 : 1 and 6.28 (standard), or 4.08 : 1, 4.70 : 1 and 5.22 : 1 (special applications only).

**OR**

Type .. .. .	Double reduction spiral bevel/double helical drive unit.
Ratio .. .. .	5.8 : 1, 6.27 : 1, 6.92 : 1 and 7.84 : 1.

**SUSPENSION**

Type .. .. .	Semi-elliptic leaf springs.
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**Road Springs, Front:—**

Length (when flat) .. .. .	54 in. (1,372 mm.).
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Width { Load carrier chassis .. .. .	4 in. (102 mm.).
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Tractor, Tipper and Passenger chassis .. .. .	3 in. (76 mm.).
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**Road Springs, Rear:—**

Length (when flat) .. .. .	54½ in. (1,384 mm.).
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Width .. .. .	3½ in. (89 mm.).
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**Helper Springs:—**

Length (effective) — Load carrier and Tipper chassis .. .. .	43 in. (1,092 mm.).
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**Hydraulic Dampers:—**

Make and Type .. .. .	Armstrong AT11, direct acting.
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**BRAKES**

Type .. .. .	Pedal controlled direct air pressure operated on all wheels with air-assisted mechanical parking brake to rear wheels. Hand controlled auxiliary braking to front wheels on tractor chassis with semi-trailer.
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Make .. .. .	Girling or †Lockheed.
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Drum Diameter .. .. .	15½ in. (394 mm.).
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Lining Width { Front .. .. .	6 in. (152 mm.).
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Rear .. .. .	8 in. (203 mm.).
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**Lining Thickness:—**

Girling .. .. .	½ in. (13 mm.).
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Lockheed .. .. .	¾ in. (19 mm.).
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Area of Linings { Foot Brake .. .. .	832 sq. in. (5,366 sq. cm.).
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Hand Brake .. .. .	476 sq. in. (3,070 sq. cm.).
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† U.K. Load Carrier only.

**AIR PRESSURE SYSTEM****Compressor:—**

Make .. .. .	AEC.
Drive .. .. .	In tandem with fuel-injection pump.
Drive Ratio .. .. .	Half engine speed.
Bore .. .. .	2.625 in. (66.7 mm.).
Stroke .. .. .	2.125 in. (53.9 mm.).
Piston Displacement (at 1,000 r.p.m. of compressor) .. .. .	13.5 cu. ft. per min. (382 litres per min.).

**Brake Air Chambers:—**

Make .. .. .	Westinghouse or Clayton Dewandre.
Type .. .. .	Single and multiple diaphragms.

Location	{	Single diaphragm	..	..	Load Carrier, Tipper and Passenger Vehicle	Tractor Vehicle with Semi-trailer
					Front axle.	—
	{	Multiple diaphragms	..	..	Rear axle.	Front and rear axles.

**AIR PRESSURE SYSTEM** (*continued*)**Air Reservoirs:—**

Make .. .. . Westinghouse or Clayton Dewandre.  
Capacity:—

		Single line braking	*Dual line braking
Load Carrier and Tipper Chassis	..	One main reservoir of 1,600 cu. in. (26.2 litres), and one auxiliary reservoir of 900 cu. in. (14.8 litres).	One reservoir of 900 cu. in. (14.8 litres), and one dual chamber reservoir of 1,600 and 800 cu. in. (26.2 and 13.1 litres).
Tractor Chassis with semi-trailer	.. .. .		*Applicable to L.H. Export Load carrier and all passenger chassis. One main reservoir of 1,600 cu. in. (26.2 litres) and one auxiliary, dual chamber reservoir of 1,600 and 800 cu. in. (26.2 and 13.1 litres).

**RADIATOR**

Type .. .. . Tube and gill plate.

**FUEL SYSTEM****Fuel Tank Capacity:—**

Load Carrier Chassis	}	..	..	40 Imperial gallons (181.8 litres).
Tractor Chassis		..	..	32 Imperial gallons (146 litres).
Passenger Chassis		..	..	"Bowl-less" type, single or twin paper element.

Main Fuel Filter .. .. .

**ELECTRICAL EQUIPMENT****Starter:—**

Make and Type .. .. . C.A.V. SL524A or BUTEC. MS3.  
Drive ratio:—  
C.A.V. .. .. . 10:138.  
BUTEC .. .. . 12:138.

**Alternator:—**

Make and Type .. .. . C.A.V. AC524, AC724 or BUTEC A3.  
Drive Ratio .. .. . See Part O of the Service Manual.

**Control Unit:—**

Make and Type .. .. . C.A.V. 440 or BUTEC R1.

**Battery:—**

Make and Type .. .. . Exide 6RHMZ15R or Oldham 6c-JA7-10FR.  
Voltage .. .. . 24 volt.  
Capacity .. .. . 110 ampere-hours.

**AIR CLEANER**

Make and Type .. .. . AC-Delco heavy duty oil bath.

**TYRES AND WHEELS****Standard Equipment:—**

		Tractor	Load Carrier and Tipper	Passenger
Tyre Size	.. .. .	9.00-20.	10.00-20.	10.00-20.
Type of Tyre	.. .. .	Radial steel cord.	High load radial steel cord.	Radial steel cord.
Rim Diameter	.. .. .	20 in. (508 mm.).	20 in. (508 mm.).	20 in. (508 mm.).
Rim Width	.. .. .	B7.0 or B6.5.	B7.0.	B7.0.

# **TYRES AND WHEELS (continued)**

## **Standard Equipment:—**

	Tractor	Load Carrier and Tipper	Passenger
Wheel Offset .. .. .	5.6 in. (142 mm.).	6.0 in. (152 mm.).	6.0 in. (152 mm.).
Wheel Type .. .. .	3 piece welded.	3 piece welded.	3 piece welded.
Number of Wheel Studs (per wheel) .. .. .	10.	10.	10.

## **Alternative Equipment:—**

Tyre Size .. .. .	10.00–20.	11.00–20.	9.00–20.
Type of Tyre .. .. .	High load radial steel cord.	High load radial steel cord.	Radial steel cord.
Rim Diameter .. .. .	20 in. (508 mm.).	20 in. (508 mm.).	20 in. (508 mm.).
Rim Width .. .. .	B7.0.	B7.5.	B7.0 or B6.5.
Wheel Offset .. .. .	6.0 in. (152 mm.).	6.3 in. (160 mm.).	5.6 in. (142 mm.).

For recommended tyre pressures, see Section 16.

# **OVERALL FINAL DRIVE RATIOS**

## **Single Reduction Axle**

Rear Axle Ratio .. .. .	*4.08 : 1	*4.7 : 1	*5.22 : 1	5.87 : 1	6.28 : 1
1st Gear .. .. .	27.1 : 1	31.16 : 1	34.16 : 1	38.91 : 1	41.64 : 1
2nd Gear .. .. .	18.1 : 1	20.87 : 1	23.18 : 1	26.06 : 1	27.88 : 1
3rd Gear .. .. .	10.4 : 1	11.94 : 1	13.26 : 1	14.90 : 1	15.95 : 1
4th Gear .. .. .	6.24 : 1	7.19 : 1	7.99 : 1	8.98 : 1	9.61 : 1
5th (Top) Gear .. .. .	4.08 : 1	4.70 : 1	5.22 : 1	5.87 : 1	6.28 : 1
6th (Overdrive) Gear .. .. .	3.06 : 1	3.52 : 1	3.92 : 1	4.40 : 1	4.71 : 1
Reverse .. .. .	26.9 : 1	30.97 : 1	34.41 : 1	38.68 : 1	41.39 : 1

\* Special applications only.

## **Double Reduction Axle**

Rear Axle Ratio .. .. .	5.8 : 1	6.27 : 1	6.92 : 1	7.84 : 1
1st Gear .. .. .	38.5 : 1	41.57 : 1	45.87 : 1	51.98 : 1
2nd Gear .. .. .	25.8 : 1	27.83 : 1	30.72 : 1	34.8 : 1
3rd Gear .. .. .	14.8 : 1	15.92 : 1	17.58 : 1	19.91 : 1
4th Gear .. .. .	8.9 : 1	9.59 : 1	10.59 : 1	12.00 : 1
5th (Top) Gear .. .. .	5.8 : 1	6.27 : 1	6.92 : 1	7.84 : 1
6th (Overdrive) Gear .. .. .	4.35 : 1	4.70 : 1	5.19 : 1	5.88 : 1
Reverse .. .. .	38.2 : 1	41.32 : 1	45.60 : 1	51.66 : 1

# **CALCULATED MAXIMUM ROAD SPEEDS (M.P.H. and K.P.H.) AT ENGINE SPEED OF 2,000 R.P.M.**

## **Rear Axle Ratio**

					Tyre Size		
					9.00–20 (523 revs./mile)	10.00–20 (503 revs./mile)	11.00–20 (492 revs./mile)
4.08 : 1	5th Gear .. .. .	..	..	..	56.3 (90.6)	58.5 (94.1)	—
	6th Gear .. .. .	..	..	..	75.0 (120.8)	78.0 (125.6)	—
4.7 : 1	5th Gear .. .. .	..	..	..	48.8 (78.5)	50.7 (81.6)	—
	6th Gear .. .. .	..	..	..	65.2 (105.0)	67.8 (109.1)	—
5.22 : 1	5th Gear .. .. .	..	..	..	43.9 (70.6)	45.7 (73.5)	—
	6th Gear .. .. .	..	..	..	58.6 (94.4)	60.8 (97.8)	—
5.8 : 1	5th Gear .. .. .	..	..	..	39.6 (63.8)	41.1 (66.1)	42.0 (67.7)
	6th Gear .. .. .	..	..	..	52.7 (84.8)	54.8 (88.0)	56.1 (90.2)
5.87 : 1	5th Gear .. .. .	..	..	..	39.8 (62.9)	40.6 (65.3)	41.5 (66.7)
	6th Gear .. .. .	..	..	..	52.2 (84.0)	54.2 (87.4)	55.5 (89.2)
6.27 : 1	5th Gear .. .. .	..	..	..	36.6 (58.9)	38.0 (61.2)	38.9 (62.6)
	6th Gear .. .. .	..	..	..	48.8 (78.6)	50.7 (81.6)	51.9 (83.5)

# **CALCULATED MAXIMUM ROAD SPEEDS (M.P.H. and K.P.H.) AT ENGINE SPEED OF 2,000 R.P.M.** (continued)

## **Rear Axle Ratio**

					<b>Tyre Size</b>		
					<b>9-00-20</b> (523 revs./mile)	<b>10-00-20</b> (503 revs./mile)	<b>11-00-20</b> (492 revs./mile)
6.28 : 1	5th Gear	..	..	..	36.5 (58.7)	38.0 (61.2)	38.9 (62.6)
	6th Gear	..	..	..	48.8 (78.6)	50.7 (81.6)	51.9 (83.3)
6.92 : 1	5th Gear	..	..	..	33.1 (53.3)	34.5 (55.5)	35.2 (56.6)
	6th Gear	..	..	..	44.2 (71.2)	46.0 (73.6)	47.0 (75.6)
7.84 : 1	5th Gear	..	..	..	29.3 (47.1)	30.4 (48.9)	31.2 (50.1)
	6th Gear	..	..	..	39.1 (62.9)	40.6 (65.4)	41.5 (66.7)

# **CALCULATED MAXIMUM ROAD SPEEDS (M.P.H. and K.P.H.) AT ENGINE SPEED OF 2,200 R.P.M.**

## **Rear Axle Ratio**

					<b>Tyre Size</b>		
					<b>9-00-20</b> (523 revs./mile)	<b>10-00-20</b> (503 revs./mile)	<b>11-00-20</b> (492 revs./mile)
5.8 : 1	5th Gear	..	..	..	43.5 (70.0)	45.25 (72.8)	46.2 (74.4)
	6th Gear	..	..	..	88.0 (93.4)	60.4 (97.1)	61.7 (99.3)
5.87 : 1	5th Gear	..	..	..	43.0 (69.2)	44.7 (71.9)	45.7 (73.5)
	6th Gear	..	..	..	57.3 (92.2)	59.7 (96.0)	61.0 (98.1)
6.27 : 1	5th Gear	..	..	..	40.2 (64.7)	41.8 (67.3)	42.7 (68.8)
	6th Gear	..	..	..	52.7 (84.8)	55.8 (89.8)	57.1 (92.0)
6.28 : 1	5th Gear	..	..	..	40.2 (64.7)	41.8 (67.3)	42.7 (68.8)
	6th Gear	..	..	..	52.7 (84.8)	55.8 (89.8)	57.2 (92.0)
6.92 : 1	5th Gear	..	..	..	36.5 (58.7)	37.9 (61.0)	38.2 (61.4)
	6th Gear	..	..	..	48.7 (78.4)	50.6 (81.5)	51.7 (83.2)
7.84 : 1	5th Gear	..	..	..	32.2 (51.8)	33.5 (53.9)	34.2 (55.0)
	6th Gear	..	..	..	43.0 (69.3)	44.7 (71.9)	45.7 (73.5)

Note:—Due to governor over-run under light load conditions the above speeds may be increased by approximately  $7\frac{1}{2}$  per cent.

# **LUBRICANT CAPACITY OF MAIN UNITS (for Lubricant Specification see Part S of the Service Manual)**

<b>Unit</b>	<b>Oil Level Indication</b>	<b>Approximate Capacity</b>	<b>Class of Lubricant</b>
Engine .. .. .	Dipstick	5 galls. (22.7 litres)	} See Lubrication Chart
Gearbox .. .. .	Filler Plug	2 galls. (9.1 litres)	
Rear Axle Casing:—			
Single reduction .. .. .	Filler Plug	2 $\frac{1}{8}$ galls. (9.65 litres)	
Double reduction .. .. .	Filler Plug	3 $\frac{3}{4}$ galls. (17.1 litres)	
Steering Box .. .. .	Filler Plug	3 $\frac{3}{4}$ pints (2.1 litres)	
Power Assisted Steering System	Visual	4 $\frac{1}{2}$ pints (2.55 litres)	
Change Speed Box .. .. .	Visual	1 pint (0.57 litre)	} Engine Oil
Oil Bath Air Cleaner .. .. .	Level Mark	$\frac{3}{4}$ pint (0.43 litre)	

## **CHASSIS AND ENGINE NUMBERS**

The chassis number will be found stamped on the frame left-hand side member at the front. The engine number is stamped on the left-hand side of the engine casing above the fuel-injection pump.

## VEHICLE OPERATING INSTRUCTIONS

ON TAKING DELIVERY OF A NEW VEHICLE OR RECOMMISSIONING A VEHICLE WHICH HAS BEEN STANDING AND BEFORE STARTING THE ENGINE, THE AIR RESERVOIR MUST BE COMPLETELY DRAINED. FOR FULL INSTRUCTIONS SEE SECTION 9.

### Before Starting the Engine

#### When using plain water as coolant

See that the radiator is full. It is advisable to fill the water cooling system to the beginning of the filler tube in the header tank. Any water in excess of that point will be discharged through the overflow pipe (see Section 10).

Soft water, preferably clean rain water, should always be used in the cooling system.

#### When using anti-freeze solution as coolant:—

Top up the cooling system. Normal loss by evaporation can be made up with plain water **provided there are no leaks in the system**. If leakage has occurred, top-up with an anti-freeze mixture of the same proportions as that already in the system.

**Note.**—When a vehicle has been exposed for a prolonged period to temperatures below the freezing point of anti-freeze solution, an ice “mush” may form, causing restrictions in the cooling system. In these circumstances, it is advisable to warm up the engine gradually until full circulation is restored. Failure to do so may result in overheating the engine, followed by boiling and consequent loss of anti-freeze solution. In addition, damage may be caused to the water pump.

#### See that:—

The oil in the engine sump is up to the “Full” mark on the dipstick.

**The oil level in the sump is maintained as near to the “Full” mark as possible, as this results in lower oil temperatures and higher lubricating qualities.**

The fuel tank contains an adequate supply of fuel.

The handbrake is hard on.

The change-speed lever is in the neutral position.

### To Start the Engine

Close the battery cut-off switch (when fitted).

Press down into the “run” position the engine stop control button located adjacent to the driver’s seat.

Move the starting switch to the “on” position.

Depress the accelerator pedal **fully**.

Press the starter button firmly.

Release the starter button as soon as the engine starts.

**If the engine does not pick up in a few seconds do not keep the starter running; to do so will exhaust the battery; wait for the engine to come to rest, then begin again.** It will sometimes be found necessary to keep the accelerator pedal more or less fully depressed

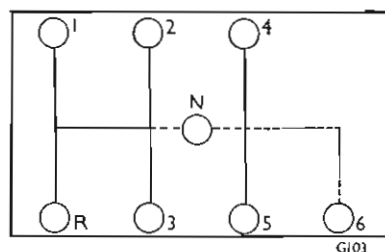


Fig. A2 Positions of change-speed lever for non-splitter gearbox

for a few moments after the engine starts, but as soon as it has warmed up slightly this may be discontinued.

**If the engine fails to pick up and accelerate rapidly,** vent the fuel system (see Section 12).

### Controls

The controls will be found in the orthodox positions.

For positions of the change-speed lever for various gears see Figure A2 or A2A. First or reverse gear is engaged by a sideways movement of the change-speed lever to the left against the action of a spring loaded ball. Sixth (overdrive) gear is obtained by pressing, to the right, the change-speed lever against spring pressure.

The parking brake is of the variable leverage, pull-on type. When applied, it will stay on until released by gripping the ratchet trigger lever to the main lever and moving them to the off position.

### To Move Off

Run the engine at about quarter speed for a few moments and then proceed as follows:—

Check that the reading on the air pressure gauge is not less than 85 lb. per sq. in. (6.0 kg. per sq. cm.).

Depress and hold down the clutch pedal.

Place the change-speed lever in 2nd gear position.

Depress the accelerator, and release the hand brake, meanwhile allowing the clutch pedal to come up slowly.

### To Change to a Higher Gear

It will be found preferable to use the “double de-clutching” method of changing up, as follows:—

Depress the clutch pedal and at the same time release the accelerator.

Move the change-speed lever to the neutral position. Momentarily release the clutch pedal and depress it again. Move the change-speed lever into the next higher gear position.

Release the clutch pedal, at the same time depressing the accelerator again.

Under normal conditions, upward gear changes should be made just before the maximum speed attainable in each gear is reached.

**IMPORTANT:**—The 6th speed (overdrive) must not be engaged at road speeds below the minimum quoted hereunder:—

Axle Ratio	Road Speed
4.7 : 1	30 m.p.h.
5.22 : 1	(48 k.p.h.)
5.8 : 1	
5.87 : 1	25 m.p.h.
6.27 : 1	(40 k.p.h.)
6.28 : 1	
6.92 : 1	
7.14 : 1	20 m.p.h.
7.84 : 1	(30 k.p.h.)
7.85 : 1	

#### To Change to a Lower Gear

The double de-clutching method of changing down is exactly the same as that for changing up except that the engine is speeded up by depressing the accelerator while the clutch pedal is released with the change-speed lever in neutral.

On hills, down changes should be made as soon as the vehicle speed drops to the maximum obtainable in the next lower gear.

**STOP the vehicle before engaging 1st gear.**

#### Chassis fitted with a 12-speed splitter gearbox (see Fig. A2A)

Preselection of the splitter ratio is by means of a tumbler switch fitted on the main change-speed lever. The "Up" position being "High" gear selection and the "Down" position the "Low" gear selection.

The splitter box is actuated by an air-cylinder; the air system being actuated, after preselecting the required ratio, by moving the main change-speed lever into the "neutral" position. At this stage, the splitter change takes place and the gear in the main gearbox can then be selected in the normal manner.

Splitter changes from "high" to "low" and a main gear change from 3rd to 4th can be achieved by preselecting "low" and changing from 3rd to 4th in the normal manner. The same method can also be adopted for a splitter change from "low" to "high" and a main gear change from 5th to 4th.

Splitter changes can, therefore, be achieved in one movement, irrespective of which particular gear the vehicle is using at the time of the change.

#### Examples

**To change from 2nd "low" to 2nd "high" (3rd Speed to 4th Speed):—**

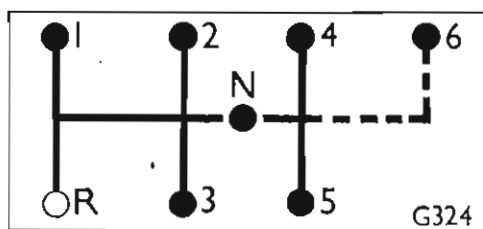


Fig. A2A. Position of change-speed lever for splitter gearbox

Move the preselector switch to the "high" position. Move the change-speed lever into "neutral" in the normal manner and then re-engage 2nd gear.

**To change from 3rd "high" to 4th "low" (6th Speed to 7th Speed):—**

Move the preselector switch to the "low" position. Move the change-speed lever into "neutral" in the normal manner and then into 4th gear.

**To change from 5th "high" to 5th "low" (10th Speed to 9th Speed):—**

Move the preselector switch to the "low" position. Move the change-speed lever into "neutral" in the normal manner and then re-engage 5th gear.

**To change from 4th "low" to 3rd "high" (7th Speed to 6th Speed):—**

Move the preselector switch to the "high" position. Move the change-speed lever into "neutral" in the normal manner and then into 3rd gear.

**Note.**—It is emphasised that the movement of the change-speed lever into "Neutral" actuates the splitter change to "high" or "low" ratio, and that all gear changes should be carried out by adjusting the engine speed in exactly the same manner as for a normal gear change.

#### Driving

Should the low air pressure or the coolant high temperature warning device operate, stop as soon as possible and investigate the cause.

Do not rest your foot on the clutch pedal when driving.

Use "top" gear as much as possible, and do not change down while the engine has the load well in hand. When climbing hills, do not wait, however, until the engine is labouring before changing down.

Do not race the engine unnecessarily, and when going up a hill in low gear, change up as soon as the speed will allow.

When descending long hills the resistance of the engine should be used as much as possible to assist in braking, by taking the foot off the accelerator pedal and leaving the vehicle in gear, so that the road wheels have then to keep the engine turning against compression. On steep hills this help must be increased by using a lower gear, using the same gear

ratio that would be required to climb the hill, but care must be taken that the vehicle is not allowed to run too fast.

**On tractor vehicles with a semi-trailer**, an auxiliary or emergency brake is fitted which is operated by a hand valve on the steering column. The auxiliary brake should be used, either with or without the foot brakes, to give added "feel" to braking and also to avoid the tendency for the trailer to "jack-knife" under extreme braking conditions.

Tables of calculated top gear road speeds in m.p.h. and k.p.h. are given on pages A7 and A8.

### Operation of the Inter-axle Differential Lock

**Note.**—The following is applicable to two-axle drive vehicles only.

If the vehicle is being driven over rough ground where driving wheel spin occurs or is likely to occur, lock the inter-axle differential by pressing the "DIFF LOCK" button. This button is located to the rear left of the driver's seat; whilst the button is depressed, positive drive is transmitted to both rear axles.

Note that the button should only be pressed when the vehicle is moving at very low speeds, or at rest, **never** when the wheels are slipping.

The "DIFF LOCK" button must be depressed for as long as wheel spin is likely to be experienced, steering as straight a course as practicable. When the vehicle is able to travel normally, release the button.

**Never press the button when driving continuously in normal conditions.**

### To Stop the Engine

Pull **up** the engine stop control button and hold it in the raised position until the engine comes to rest.

### Before Leaving the Vehicle at Night

Apply the parking brake.

Place the change-speed lever in neutral position.

Switch off the lights and the "Start" switch on the instrument panel.

Move the battery isolating switch (when fitted) to the "Off" position.

In cold weather, see that the "Frost Precautions" are observed.

### Draining and Filling of the Cooling System

**As a safety precaution it is advisable not to open the filler cap whilst the engine is running, to prevent the possibility of very hot water being forced out.**

Cold coolant, whether water or anti-freeze solution, **should never** be put into the radiator whilst the engine is hot.

If at any time the cooling system is drained, it is recommended that the drain cock is left **open**.

When refilling the system, observe that the coolant is flowing from the cock before closing it. This will prevent air locks.

After closing the cock complete the filling of the system.

### Cab—Tilt Mechanism (see Figs. A3, A4 and A19)

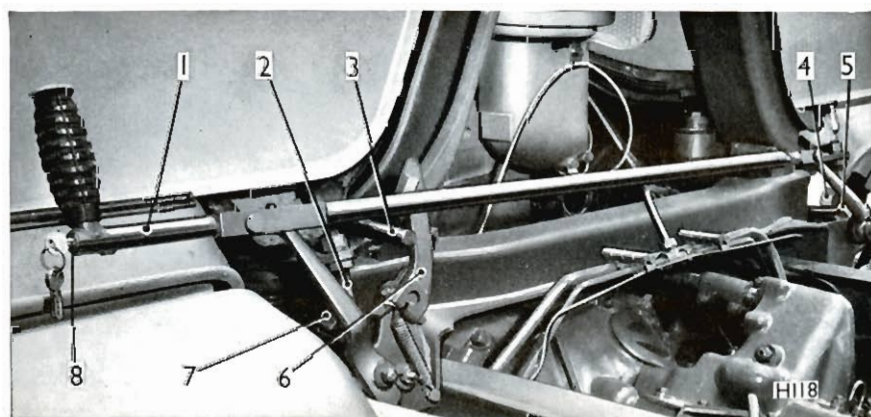
Before tilting the cab:—

**Ensure that all loose articles inside the cab are removed or secured and, it is emphasised that any additional load mounted on the roof, MUST be removed.**

Ensure that the seat vertical adjustment handle at the front of the driver's seat is pointing **downwards**, then unlock the driver's seat with the lever and tilt the seat forward.

### To Tilt

Unscrew the locking screws and release the safety lever, or alternatively, unlock the transverse lever with the key and push the lever to free the cab stirrups from the holding down hooks on the chassis frame. A



#### Key to Numbers:—

1. TRANSVERSE LEVER  
2. CAB STIRRUP

3. TILT BEAM  
4. HOLDING DOWN LOCK

5. CAB STIRRUP  
6. SAFETY CATCH

7. HOLDING DOWN LOCK  
8. LOCK—TRANSVERSE LEVER

Fig. A3 Tilt cab locking gear—early type

second push on the lever will free the safety catch; the cab may then be tilted.

#### Hydraulic Tilt (when fitted)

Using the handle provided, move the valve pin on the side of the tilt cab pump to the "LIFT" position then, using the same handle, operate the pump rocker arm to tilt the cab.

#### To Hold

Secure the cab in the tilted position by connecting the safety stay on the tilt beam with the catch plate on the chassis frame.

#### To Return and Lock the Cab

Ensure the driver's seat is tilted forward.

Carefully lower the cab on to its seating and screw home the locking screws until the clamping rings are tight against the boss on the cab arch cross member brackets; engage the safety lever. Alternatively pull the lever until the holding down hooks are fully engaged and **lock the transverse lever with the key**.

Return the driver's seat to its normal position.

#### Hydraulic Tilt (when fitted)

Move the valve pin to the "LOWER" position then pump a few times to bring the cab over the "top centre" position. The cab will then return fully under its own weight.

#### Towing

Two detachable towing eyes are supplied in the tool

kit; to tow the vehicle, remove the front grille and screw the eyes into the tapped holes provided.

#### Frost Precautions

Vehicles with anti-freeze mixture in the engine cooling system should be marked to that effect.

If the vehicle is so marked:—

**Do not** drain the cooling system.

If anti-freeze solution is **not** in use and the vehicle is to remain standing in the open with temperatures approaching freezing point, the cooling system must be completely drained. Open the drain cock at the rear of the cylinder block (when fitted), and the drain cock or cocks provided adjacent to the bottom left-hand side of the radiator.

The drain cock(s) must be tested at frequent intervals by inserting a piece of wire to ensure that it/they is/are clear.

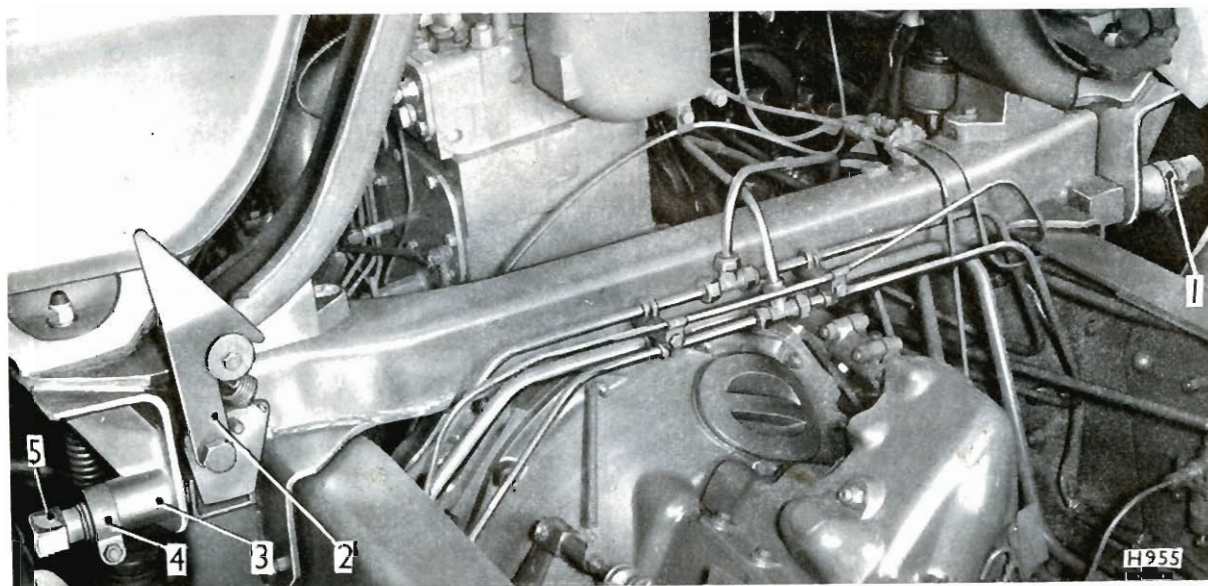
This should be done immediately the cock(s) is/are opened so that any obstruction freed by the wire may be flushed out by the water.

Drain when the engine is hot, and do not leave the vehicle until the water is properly drained.

After draining, place a notice on the radiator to the effect that the cooling system is empty and the drain cock(s) is/are open.

#### Anti-freeze Mixture

For specification and method of changing over to anti-freeze mixture see Section 18.



#### Key to Numbers:—

- 1. LOCKING SCREW AND CLAMP RING
- 2. SAFETY CATCH

- 3. BOSS—CAB ARCH CROSS MEMBER
- 4. CLAMP RING
- 5. LOCKING SCREW

Fig. A4 Tilt cab locking gear—late type

## ROUTINE MAINTENANCE PROGRAMME

It is appreciated that many operators will already have in operation a system of inspection and maintenance which has been shown by experience to be suitable for their particular operating conditions. The following charts are principally intended as a guide for those who have not had previous experience on which to base such a system of maintenance and inspection, but it is hoped that they will also be of use to experienced operators in maintaining their vehicles.

It is stressed that only by regular attention in accordance with a system similar to that detailed below can the high standard of performance and reliability of AEC products be maintained.

In the case of a new or overhauled vehicle, dock days should be held after the first 500 miles (800 km.) and 1,000 miles (1,500 km.) when the particular items listed below should receive attention.

Where reference is made to the Service Manual, the item is considered to constitute a workshop operation.

### AFTER THE FIRST 500 MILES (800 KM.) OF A NEW OR OVERHAULED VEHICLE

#### Engine

Tighten down the cylinder heads with a torque spanner to the correct torque loading (*see Section 1*).

### AFTER THE FIRST 1,000 MILES (1,500 KM.) OF A NEW OR OVERHAULED VEHICLE

#### Engine

Drain the sump (*see Section 1*).

Renew the oil filter element (*see Section 1*).

Fill the sump with fresh oil; for details of procedure see under "Monthly" (*see Section 1*).

Check the injector opening pressures (*see Part B of the Service Manual*).

Check inlet and exhaust valve tappet clearances (*see Section 1*).

#### Gearbox

Drain oil, clean the magnetic filter attached to the oil drain plug and refill (*see Section 3*).

Tighten all side and cover bolts to prevent lubricant leakage.

#### Steering

Check for tightness the drop arm securing nut and the bolts securing the steering box.

Examine the drag link ends and check the lock and clamp bolts for tightness.

Renew the filter in the power steering oil supply tank (*see Section 5*).

#### Front Axle(s)

Check the front wheel alignment (*see Part G of the Service Manual*).

#### Rear Axle(s), Driving

Drain oil and refill (*see Section 7*).

#### Suspension

Check the spring and shackle pins, spring securing bolts and clips for tightness.

On the fully articulated rear bogie, check all axle securing bolts and bogie bracket bolts for tightness. Check the torque rod securing nuts for tightness (*see Part J of the Service Manual*).

### DAILY

Attend to "Daily" items detailed in the Lubrication Chart (*at the end of the book*).

#### Air Pressure System

Drain the moisture from the reservoirs (*see Section 9*). This may be extended to a "Weekly" attention depending on climatic conditions.

#### Tyres and Wheels

Check tyre pressures and tightness of the wheel nuts (*see Section 16*).

**WEEKLY**

Attend to "Weekly" items detailed on the Lubrication Chart (*at the end of this book*).

**Engine**

Remove, clean and refill the oil bath cleaner; also remove the pre-cleaner (when fitted) (*see Section 1*). This may be extended to a "Monthly" attention, depending on climatic conditions.

**Clutch**

Check the level of fluid in the supply tank of the hydraulic system (*see Section 2*).

Check the clutch pedal adjustment (*see Section 2 and Part C of the Service Manual*).

**Steering**

Check the oil level in the supply tank for the power assisted steering (*see Section 5*).

**Braking System**

Check both parking and foot brake adjustments (*see Part K of the Service Manual*).

**Air Pressure System**

Drain the moisture from the air reservoir(s) (*see also under "Daily" and Section 9*).

If the air compressor cylinder head has recently been removed, check that the holding down bolts are fully tightened (*see Part B of the Service Manual*).

**Electrical Equipment**

Check that tops of batteries are clean and dry.

**MONTHLY OR 5,000 MILES (8,000 KM.)**

Attend to "Monthly" items detailed on the Lubrication Chart.

**Engine**

Drain the sump, preferably with engine warm. **Renew** the oil filter element (*see Section 1*).

Refill the sump with fresh oil (*see Section 1*).

Remove, clean, refill and fit the oil bath air cleaner (*see also under "Weekly" and Section 1*).

Check inlet and exhaust valve tappet clearances (*see Section 1*).

Check the tension of the fan, water pump and alternator drive belts (*see Section 1*).

Check the fuel, oil and water pipes for security and leakage.

**Gearbox**

Clean the breather (*see Section 3*).

**Steering Gear**

Check for tightness the drop arm securing nuts and the bolts securing the steering box. Examine the drag link ends and check the lock and clamp bolts for tightness.

Check the power assisted steering system for oil leakage and ensure that all the valves in the system are operating correctly (*see Section 5 and Part F of the Service Manual*).

**Front Axle(s)**

Examine track rod ends and lock and clamp bolts for tightness, also check the swivel securing nuts. Examine the hub for lubricant leakage (*see Section 6*).

**Rear Axle(s) Driving**

Clean the breather (*see Section 7*).

Inspect the casing(s) for lubricant leakage, tightening nuts and bolts, if necessary (*see Section 7*).

**Suspension**

Check the spring and shackle pins, spring securing bolts and clips for tightness.

On the fully articulated rear bogie, check the torque rod securing nuts for tightness. Examine the bonded-rubber bushed bearings in the torque rods for deterioration (*see Part J of the Service Manual*).

**Brakes**

Check the brake linings for wear and clearance through the apertures in the brake dust shields.

Check for tightness the brake air chamber mountings.

**Air Pressure System**

Test the air system for leakage and check the time for pressure build up (*see Section 9 and Part K of the Service Manual*).

Examine all flexible air pipes for signs of chafing or wear and renew if necessary.

Check that the exhaust vent on the quick release valve (when fitted) is free from obstruction.

**MONTHLY OR 5,000 MILES (8,000 KM.)** *(continued)***Fuel System**

- Clean the air vent hole on the fuel tank filler cap.
- Check all fuel pipes for security and leakage.

**Electrical Equipment**

- Clean the tops of the batteries, top-up the batteries with distilled water, clean the terminals and coat them with petroleum jelly (**NOT GREASE**) (*see Section 13*).

**EVERY 10,000 MILES (16,000 KM.)****Engine**

- Remove the injectors; strip, clean and reset the opening pressures (*see Part B of the Service Manual*).

**Air Pressure System**

- Check all steel pipes for corrosion.
- Remove all flexible pipes in the system and test them at 250 lb. per sq. in. (18 Kg. per sq. cm.) when no leakage should occur.
- Check that the filter elements on the load sensing valve (when fitted) are free from obstruction.
- Examine the rubber gaiters on the load sensing valve and knuckle joint for damage or deterioration and renew if necessary (*see Part K of the Service Manual*).
- Check the operation of the shock absorber in the linkage to the load sensing valve and if necessary renew (*see Part K of the Service Manual*). Lubricate the linkage connections.

**EVERY 15,000 MILES (25,000 KM.)****Engine**

- Check the drive coupling and timing of the fuel-injection pump—in-line pump only (*see Part B of the Service Manual*).

**Front Axle(s)**

- Check the front wheel alignment (*see Part G of the Service Manual*).
- Check the steering lock (*see Parts F and G of the Service Manual*).
- Check the hub bearing adjustment (*see Part G of the Service Manual*).

**Rear Axle(s)**

- Check all joints for lubricant leakage (*see Section 7*).
- Check the hub bearing adjustment (*see Part H of the Service Manual*).

**Air Pressure System**

- Remove the compressor cylinder head; clean the compressor delivery valves and check their springs (*see Part B of the Service Manual*).
- Remove and decarbonize the outlet pipe from the compressor to the unloader valve; clean all air filters and strainers in the system (*see Part K of the Service Manual*).

**Fuel System**

- Clean the fuel filter base; renew the element and vent the fuel system (*see Section 12*).

**Electrical Equipment**

- Examine the starter motor commutator and brushes.
- Check the specific gravity of the battery electrolyte. If below the correct value, check the voltage output from the control unit (*see Part O of the Service Manual*).

**EVERY 30,000 MILES (50,000 KM.)****Gearbox**

- Drain oil, clean the magnetic filter attached to the oil drain plug and refill (*see Section 3*).

**Rear Axle(s), Driving**

- Drain oil and refill (*see Section 7*).

**Suspension**

- Check the spring eyes for side play (*see Section 8*).

**EVERY 50,000 MILES (80,000 KM.)****Engine**

Remove the cylinder heads, decarbonize, and carry out a general inspection (*see Part B of the Service Manual*).  
 Remove fuel-injection pump, test and recalibrate if necessary (*see Part B of the Service Manual*).  
 Facilities for testing and calibrating the fuel injection pumps are available at AEC Depots and Agents.  
 (List of addresses available on request).

**Clutch**

Renew operating cylinder piston seals (*see Part C of the Service Manual*).

**Steering**

Renew the filter in the power steering oil supply tank (*see Section 5*).

**Air Pressure System**

Dismantle the brake chambers and renew the diaphragms (or every 12 months which ever is sooner) (*see Part K of the Service Manual*).  
 Dismantle the quick release valve (when fitted), clean and inspect for wear (*see Part K of the Service Manual*).  
 Remove and overhaul the air compressor (*see Part B of the Service Manual*).  
 Remove and overhaul the unloader valve (*see Part K of the Service Manual*).  
 When applicable, remove and overhaul the load sensing valve and knuckle joint (*see Part K of the Service Manual*).

**Electrical Equipment**

Examine the alternator brushes and slip rings (*see Part O of the Service Manual*).

**EVERY 100,000 MILES (160,000 KM.)****Engine**

Remove the pistons, clean and inspect the interior of the engine (*see Part B of the Service Manual*).

**Flywheel**

Check the teeth of the starter ring for wear (*see Part B of the Service Manual*).

**NORMAL PERIODICAL OIL CHANGES FOR UNITS**

Engine ..	..	..	..	..	..	..	..	..	..	..	5,000 miles (8,000 km.).
Gearbox ..	..	..	..	..	..	..	..	..	..	..	30,000 miles (50,000 km.).
Rear Axle ..	..	..	..	..	..	..	..	..	..	..	30,000 miles (50,000 km.).

For approximate capacities of Main Units see Page A7 or A8.

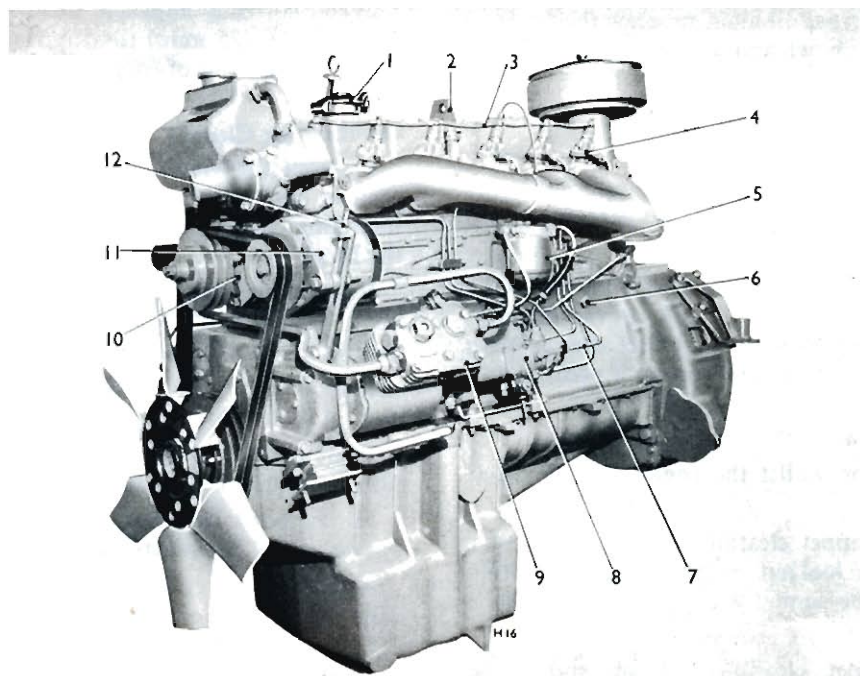
**Note.**—Provided that engine oil to the correct specification as recommended by AEC has been used it is only necessary to clean the sump oil strainer at overhaul periods.

## DESCRIPTION AND MAINTENANCE OF UNITS

**Note.**—See table on page A7 or A8 for the quantity and Part S of the Service Manual for the Specification of the lubricants quoted in the following text.

### Section 1

### ENGINE



#### Key to Numbers:—

- |                                  |                               |                     |
|----------------------------------|-------------------------------|---------------------|
| 1. OIL FILLER CAP                | 5. FUEL FILTER                | 9. AIR COMPRESSOR   |
| 2. ENGINE LIFTING EYE            | 6. CYLINDER WATER DRAIN POINT | 10. WATER PUMP      |
| 3. INJECTOR DRIBBLE GALLERY PIPE | 7. FUEL DELIVERY PIPE         | 11. ALTERNATOR      |
| 4. FUEL INJECTOR                 | 8. FUEL-INJECTION PUMP        | 12. BELT ADJUSTMENT |

Fig. A5 Front three-quarter view of engine

#### Description

The engine is of the six cylinder, vertical, direct injection type, the engine casing and cylinder block being of integral construction incorporating dry cylinder liners. The joint face between the engine casing and the sump is along the centre line of the crankshaft.

The crankshaft is carried in shell precision type main bearings.

Two identical cylinder heads, each covering three cylinders, carry the push rod operated valves, valve rocker gear and injectors.

Wet sump lubrication is maintained by a gear type oil pressure pump mounted on the main bearing cap. The pump draws oil through the gauze strainer in the

sump and delivers it through an external oil filter at high pressure to the crankshaft and connecting rod big-end bearings.

A twin cylinder air compressor, and when applicable, a hydraulic oil pump for power assisted steering are fitted to the engine, the drive being taken from opposite sides of the timing-gear train.

The fuel-injection pump, fuel filter, thermostat and alternator are engine mounted.

The oil filler is situated on top of the front valve cover, whilst an oil bath type air cleaner is connected directly to the air induction manifold. The header tank for filling the cooling system is mounted as shown in Figure A5.

The water pump, fan and alternator are driven from the crankshaft by a "V" belt drive.

## Maintenance

At periods quoted in the Routine Maintenance Programme, attend to the following:—

### Lubrication

Drain the oil from the engine by removing the drain plug from the sump.

To clean the external oil filter, unscrew the setscrew in the end of the bowl and remove the bowl and filter element.

**Renew** the element (it cannot be cleaned) and wash the remaining parts in clean paraffin. Allow to drain.

When fitting the bowl and element, ensure that the sealing joint is serviceable and is fitted between the oil filter head and its mounting.

Fill the engine, through the oil filler attached to the valve cover, up to the "Full" mark on the dipstick, with clean engine oil. Check the oil level after running the engine for five minutes and top-up if necessary.

### Tappet Adjustment

This can be done whilst the engine is running at **idling speed**.

To adjust the tappet clearance, remove the valve cover, slacken the locknut on the tappet adjusting screw, and turn the screw, which is slotted, with a screwdriver.

Check the tappet clearance, which should be 0.010 in. to 0.012 in. (0.25 to 0.30 mm.) between each valve thimble and rocker pad, for both inlet and exhaust valves, when the engine is **HOT**.

When the correct clearance is obtained, hold the adjusting screw in position with the screwdriver, and at the same time tighten the locknut.

### Tightening Cylinder Heads

Check for tightness the cylinder head securing nuts, using the sequence as shown in Fig. A6 and tightening to the specified torque loading of 100 lb. ft. (13.8 kg. m.).

Adjust the tappet clearance as previously instructed.

## Drive Belts

Slacken the hinge bolts securing the alternator to the support bracket on the engine casing, and the clamp nuts on the adjusting arm.

Rotate the adjusting nut in the required direction to adjust the belts; finally, tighten the clamp nuts, hinge bolts and adjusting nut.

When correctly adjusted, there should be approximately 1 in. (25 mm.) total movement in the centre of the vertical run of each belt without any slipping.

## Oil Bath Air Cleaner

Unscrew the wing nut on top of the air cleaner and remove the cleaner complete from the air intake mounting taking care not to spill the oil contained in the bowl.

Remove the filter element from the base portion and wash the filter element thoroughly in clean paraffin; then allow to drain.

Drain the oil from the base portion of the bowl and clean out any sediment.

Examine the sealing rings in the bowl for deterioration and renew if necessary.

Fill the bowl with clean engine oil to the **level mark**, but **do not fill beyond this mark**.

Assemble the cleaner and refit; ensure that the wing nut is well tightened.

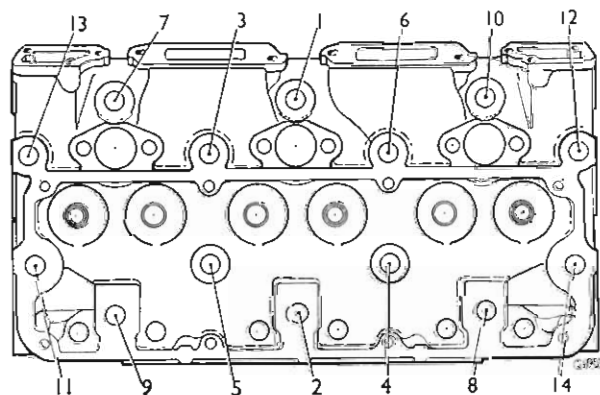


Fig. A6 Sequence of tightening cylinder head nuts

## Section 2

## CLUTCH

### Description

The clutch is of the single dry plate type, the driven plate, housing an internally splined centre, engages the splines on the gearbox primary shaft.

The driven plate is rigidly connected to the splined centre and the friction linings are held on either side of the driven plate by flush fitting inserts.

Actuating pressure is supplied by a series of coil

springs between the cover and pressure plates.

Release levers for clutch withdrawal are pivoted from pins which are carried in pads on the cover plate. A strut is fitted between the outer end of each release lever and the pressure plate. Springs retain the strut in position on the outer end and also support the release lever plate on the inner end of the lever.

The clutch withdrawal bearing is carried on a

sleeve bolted to the gearbox; the bearing is enclosed in an outer housing which is recessed to engage and rotate with the clutch release levers. The inner race of the bearing and its housing is prevented from rotating by pegs which make contact with the withdrawal levers.

The withdrawal mechanism is actuated by a hydraulic slave cylinder on the side of the gearbox. The slave cylinder is actuated by a master cylinder which in turn is operated by the clutch pedal.

### Maintenance

At periods quoted in the Routine Maintenance Programme, check the level of hydraulic fluid in the supply tank, located at the rear offside of the engine and top-up if necessary. **Do not fill above three-quarters full.**

**Except in most exceptional circumstances, which will be specially approved, use only Standard Crimson Hydraulic Brake Fluid conforming to S.A.E. Specification No. 70R1 or 70R3. It is preferable to avoid mixing different makes of fluid.**

A rapid or considerable fall in the fluid level indicates a leak at some point in the hydraulic system, which must be found and rectified.

To check for leaks, depress and release the clutch pedal a number of times and then hold down firmly, whilst an assistant examines the pipes and connections in the system.

If leakage is apparent, correct and afterwards bleed the hydraulic system.

Ensure that the vent hole in the supply tank filler cap is clear, otherwise pressure may be built up in the system.

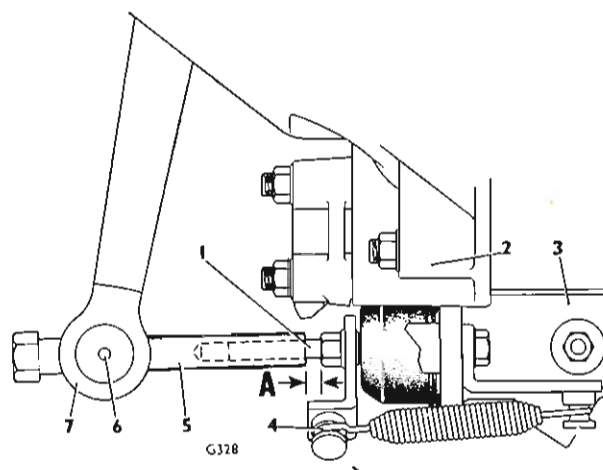
### To Adjust

The hydraulic clutch release system is either of the "Hydrostatic" or "Non-Hydrostatic" type and is adjusted as follows:—

#### Clutch Pedal—Free Movement

##### Both Types

The free movement of the clutch pedal should be approximately  $\frac{3}{8}$  in. (16 mm.) before the push-rod contacts the piston in the **master cylinder**. If adjustment is necessary, slacken the locknut on the master cylinder push-rod and adjust the rod until the pedal has the correct free movement, then tighten the locknut.



Key to Letter and Numbers:—

- |  |                                    |
|--|------------------------------------|
| <b>DIMENSION "A"</b> $\frac{7}{8}$ in. (5 mm.) | 4. PUSH ROD RETURN SPRING          |
| 1. PUSH ROD ADAPTOR                            | 5. CLUTCH OPERATING ROD            |
| 2. GEARBOX CASING                              | 6. HELILOCK INSERT IN TRUNNION PIN |
| 3. HYDRAULIC SLAVE CYLINDER                    | 7. CLUTCH WITHDRAWAL LEVER         |

Fig. A7 Clutch withdrawal lever setting dimensions (Non-hydraulic system)

### Hydrostatic System (Long Stroke Slave Cylinder)

Providing that the slave hydraulic cylinder has been connected to the operating lever as instructed in Part C, no further adjustment is necessary with this system.

### Non-Hydrostatic System—Short Stroke Slave Cylinder (see Fig. A7)

In addition to the original  $\frac{3}{8}$  in. (16 mm.) setting of the pedal, a **further** free movement of approximately  $1\frac{1}{8}$  in. (35 mm.), making a total of 2 in. (51 mm.) is necessary to maintain a running clearance between the clutch release levers and the withdrawal bearing.

To obtain this, proceed as follows:—

Slacken the locknut on the clutch operating rod and push the clutch withdrawal lever towards the gearbox until the release bearing is hard against the clutch release levers.

Hold the lever in this position and push the adaptor rod towards the slave cylinder so that the piston in the cylinder is fully retracted, then screw the operating rod outwards until dimension "A" is obtained and tighten the locknut.

## Section 3

## GEARBOX

For information on the splitter gearbox refer to Supplement D (TSL-3412)

## Description

Unit mounted with the engine, the gearbox provides six forward speeds and a reverse. With the exception of 1st speed and reverse, which have sliding mesh engagement, all other gears operate in constant mesh.

The sixth speed overdrive gears are mounted at the rear ends of the main and layshafts and are housed within an extension casing bolted to the rear of the gearbox casing.

The striking and selector mechanism, which is enclosed in a detachable casing mounted on top of the gearbox, incorporates a ball type selector interlock to prevent more than one gear being engaged at a time.

Accidental engagement of first and reverse gears, and overdrive gear, is prevented by spring loaded plungers fitted either side of the striking lever.

To obtain the correct relationship between the change speed lever and gearbox selector mechanism, a muff coupling is fitted between the two units. The coupling is locked by clamp bolts in the grooved ends of the swivel shafts and provides a means of adjustment between the shafts.

Apertures are provided in the side of the gearbox

for fitting a high or low speed power take-off, if required.

The high speed power take-off houses two shafts mounted in parallel and carrying respectively the idler and driven gears, the idler gear being moved into engagement with the fourth speed layshaft gear wheel by a selector mechanism.

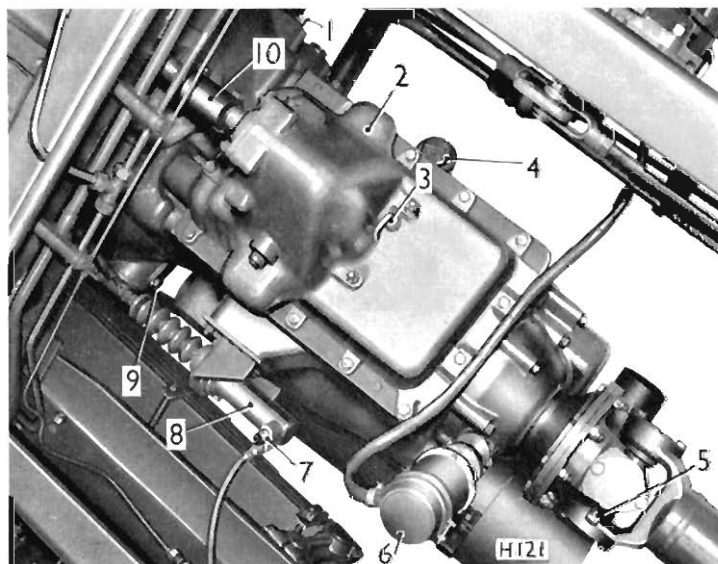
Alternatively, a full torque low speed power take-off may be fitted, which consists of a splined shaft and drive gear driven from the primary shaft, the drive being engaged by a forked striking rod.

Both the high and low speed take-off units have a spring loaded ball type interlock incorporated in the selector mechanism.

A speedometer drive is taken from the rear end of the gearbox mainshaft.

Gearbox lubrication is by splash and oil mist. The oil filler plug is screwed into an extended filler and level tube on the right-hand side of the gearbox. A combined drain plug and magnetic filter is situated in the well of the main casing; a second drain plug is provided in the extension casing at the rear of the gearbox.

A pipe type oil breather is located in the top of the striking and selector mechanism casing.



## Key to Numbers:—

- |  |   |   |
|--|---|---|
| 1. LUBRICATOR—CLUTCH WITHDRAWAL BEARING  | 4. OIL FILLER AND LEVEL PLUG            | 6. HYDRAULIC SLAVE CYLINDER             |
| 2. COVER—STRIKING AND SELECTOR MECHANISM | 5. LUBRICATOR—UNIVERSAL JOINT           | 9. LUBRICATOR—CLUTCH WITHDRAWAL BEARING |
| 3. BREATHER PIPE                         | 6. ELECTRIC SPEEDOMETER                 | 10. MUFF COUPLING                       |
|  | 7. BLEED SCREW—HYDRAULIC SLAVE CYLINDER |   |

Fig. A8 Overhead view of gearbox

### Maintenance

At the periods quoted in the Routine Maintenance Programme, attend to the following:—

Drain the oil in the gearbox and refill to the level of the **bottom thread** of the filler plug hole.

To fill or top-up the change speed box, remove the level plug; then slide the rubber gaiter up the change-speed lever, out of the way. Remove the nuts securing

the change-speed seating to the box, raise the seating cap and shims and pour in oil up to the level plug hole. Refit the level plug.

Clean the magnetic type oil filter by washing in clean paraffin; also ensure that the breather on the selector casing is free to breathe.

Examine the gearbox for lubricant leakage and if necessary tighten up the nuts on the side and end cover to compensate for joint shrinkage.

## Section 4

### PROPELLER SHAFTS

#### Description

The chassis are fitted with one or two propeller shafts between the gearbox and rear axle, dependent upon the wheelbase. When two driving axles are fitted, an additional shaft transmits the drive from the first axle to the second axle.

Each shaft is of tubular construction, incorporating needle roller bearing universal joints.

When more than one shaft is fitted between the gearbox and rear axle, the forward shaft is supported

by an intermediate bearing.

A relief valve and lubricator are incorporated in the star piece of each universal joint.

#### Maintenance

At periods quoted in the Lubrication Chart, lubricate the universal joints, sliding ends and (when fitted) the intermediate bearing with grease. Inject the lubricant into the universal joint until it shows at the relief valve.

## Section 5

### STEERING GEAR

#### Description

The steering is of the worm and recirculatory ball nut type in which the arms of the rocker shaft carry the ball nut by means of ball pegs which engage with conical sockets in the nut. The ball pegs are formed integrally with a flange which is shimmed to the outer faces of the rocker arms and locked in position by setscrews.

The recirculatory balls travel under load through helices in the nut and are transferred by a communicating tube which is held to the nut by a retaining clip.

The upper end of the steering shaft is carried by a self aligning bearing which permits a limited amount of swing to accommodate the arcuate path of the recirculatory ball nut. The bearing is pre-loaded by an adjustable race and is supported in the housing by a resilient ring which absorbs the shock.

Centralizing adjusters are fitted on either side of the rocker shaft, to enable the steering shaft to be adjusted correctly.

Oil bath lubrication is provided for the worm, recirculatory balls, nut and rocker shaft; an oil filler plug being fitted in the top of the steering box adjacent to the column. The oil retainer on the rocker shaft is

of the lip seal type and is located in the steering box casing.

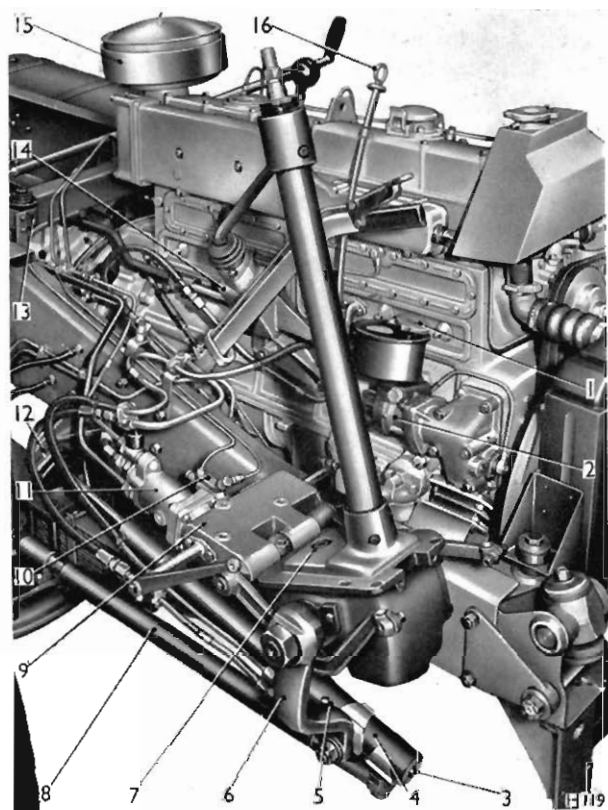
Serrations on the rocker shaft allow the steering drop arm to be correctly positioned during assembly.

Motion is transmitted from the drop arm by a drag link to the front axle swivel lever. Adjustable ball and socket ends are fitted at either end of the drag link. The screw threads of the socket ends are handed to enable the drag link to be turned and thus facilitate adjustment to the correct length.

**Power assistance** (when fitted) is provided by a direct-coupled hydraulic system consisting of a double-acting power cylinder and an engine mounted hydraulic roller type pump.

The pump, incorporating flow regulating and relief valves, is mounted on the right-hand side of the engine casing and is driven by the timing gear train. The oil supply tank for the hydraulic system is integral with the pump (see Fig. A9).

The double-acting ram, the rear end of which is mounted on the frame side member, is attached at its front end to the steering drop arm and the axle steering arm drag link.



#### Key to Numbers:—

1. FILLER CAP—HYDRAULIC SUPPLY TANK
2. HYDRAULIC OIL PUMP—POWER ASSISTED STEERING
3. LUBRICATOR—BALL STUD
4. HYDRAULIC CYLINDER
5. LUBRICATOR—BALL STUD
6. DROP ARM
7. FILLER PLUG—STEERING BOX
8. DRAG LINK
9. PEDAL BRACKET
10. HYDRAULIC MASTER CYLINDER—CLUTCH
11. BRAKE VALVE
12. LUBRICATOR—HYDRAULIC RAM ANCHORAGE
13. HYDRAULIC SUPPLY TANK—CLUTCH
14. CHANGE SPEED BOX
15. OIL BATH AIR CLEANER
16. DIPSTICK

Fig. A9 Steering Assembly

A control valve spool fitted in the ram is operated by the movement of the steering drop arm drag link; the movement of the spool admitting oil pressure to the appropriate side of the ram, thus providing power assistance.

A centring force for both directions of control valve spool displacement is provided, an effect of which is to give the driver some steering "feel".

Should the pump fail to deliver oil under pressure, the manually operated control valve spool is forced against an internal stop, admitting oil to both sides of the ram and allowing the full manual steering effort to be transmitted to the axles without having to force oil back through the pump.

#### Maintenance

At periods quoted in the Routine Maintenance Programme, attend to the following:—

Inspect the steering box in the vicinity of the rocker shaft oil seal for leakage (*see Part F of the Service Manual*).

If necessary, lift the rubber floor surround or remove the rubber plug to gain access to the steering box and top-up with oil to the level of the filler plug.

Lubricate the drag link and track rod ends.

**Where power assisted steering is fitted** check the following:—

See that the ram is securely anchored to the frame.

Examine all pipe connections for leakage.

#### To Renew the filter element

Disconnect the pipe from the base of the oil reservoir and drain the oil into a container.

Remove the setscrew, metal washer and sealing washer which secure the cover; remove the cover, gasket and spring and withdraw the filter element.

**Renew** the filter element (it cannot be cleaned).

**Note.**—The setscrew which secures the reservoir cover should be tightened to a torque loading of 40 to 60 lb. in. (4.6 to 6.9 kg. cm).

Refill the supply tank until the oil just covers the filter.

To ensure that all the air is expelled from the system after dismantling or maintenance, start the engine and allow it to idle for a few minutes. With the engine idling, turn the steering wheel several times to both full lock positions. Stop the engine and top-up the supply tank if necessary.

## Section 6

## FRONT AXLE(S)

### Description

The front axle is of the reversed Elliot type, the swivels being carried in bushes with the thrust taken on hardened steel pads.

**On early load carrier chassis**, each hub is carried on taper roller bearings which are adjustable by means of a split nut held by a clamp bolt and locked by a set-screw giving vernier adjustment. **On all other chassis**, the hub bearings are adjusted by a split nut and locked with a clamp bolt, there being no vernier adjustment.

Surplus lubricant in the hub is diverted away from the brake shoes via pressed steel guards, and ejected through a hole in the torque plate to the outside of the wheels.

Adjustable steering lock stops are fitted behind the swivels to limit the lock on the road wheels.

Adjustment of the track rod ends may be carried out without disturbing the track setting.

### Maintenance

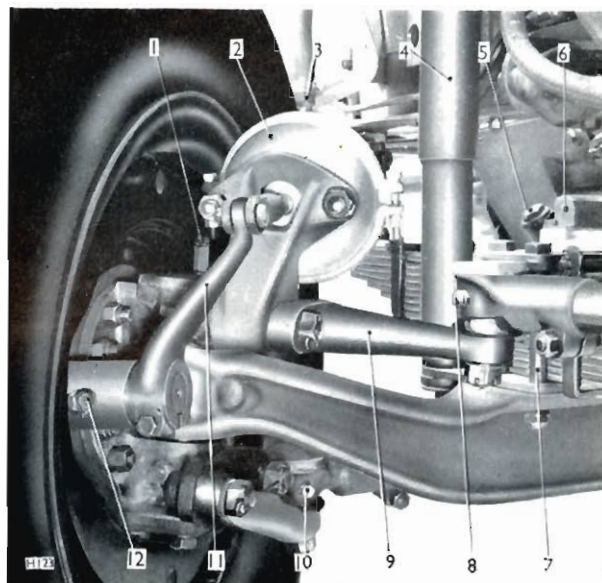
At the periods quoted in the Routine Maintenance Programme, attend to the following:—

Lubricate the points detailed in the Lubrication Chart.

Examine the surplus lubricant escape holes for signs of lubricant. If this is visible, it indicates that either too much lubricant has been applied to the hub bearings, or that the hub seal requires renewing.

Check the maximum lock in both directions so as to prevent the steering nut from coming to the end of its travel, also the tyres fouling any part of the chassis. If necessary, adjust the lock stop setscrews.

The hubs do not require lubrication between overhaul periods.



### Key to Numbers:—

1. LUBRICATOR—SWIVEL PIN (used for dirt exclusion only)
2. BRAKE AIR CHAMBER
3. FLEXIBLE AIR SUPPLY HOSE TO BRAKE CHAMBER
4. HYDRAULIC DAMPER
5. OIL FILLER AND LEVEL PLUG—GEARBOX
6. AXLE BUMP STOP
7. SPRING SECURING BOLT
8. LUBRICATOR—ORAG LINK END SOCKET
9. SWIVEL LEVER
10. LUBRICATOR—TRACK ROD END SOCKET
11. BRAKE CAMSHAFT LEVER
12. LUBRICATOR—BRAKE CAMSHAFT

Fig. A10 Typical front axle

## Section 7

## REAR AXLE(S)

### Description

#### Single Drive, Single Reduction Axle

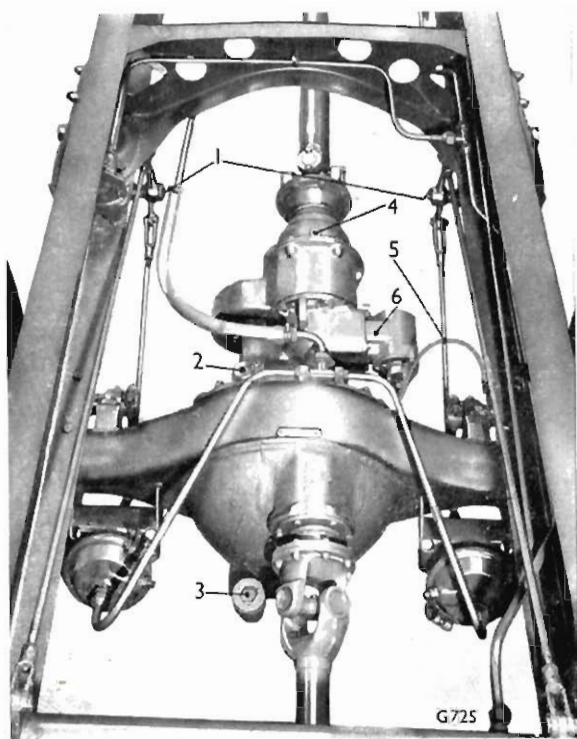
The axle is of the spiral bevel type, the drive being transmitted through the bevel pinion to a bevel wheel containing the differential unit.

The drive through the pinion, bevel wheel and differential unit is carried in taper roller bearings, except the pinion spigot bearing which is a parallel roller.

#### Single Drive, Double Reduction Axle

The axle is of the double reduction, spiral bevel and double helical gearing type.

The drive is transmitted through a spiral bevel pinion and wheel to a transversely mounted double helical shaft meshing in a double helical wheel containing the differential assembly. The drive components are carried in a combination of ball, parallel



#### Key to Numbers:—

1. LUBRICATORS—HANDBRAKE  
RELAY LEVERS
2. AXLE CASING BREATHER
3. FILLER PLUG
4. THIRD DIFFERENTIAL  
HOUSING FILLER PLUG
5. AIR SUPPLY PIPE—THIRD  
DIFFERENTIAL LOCK
6. THIRD DIFFERENTIAL LOCK  
SELECTOR HOUSING

Fig. A11 Single reduction axle with third differential and power divider

and taper roller bearings located in the reduction casing.

#### Two Axle Drive, Single Reduction Axles

Both axles are of the spiral bevel type, power being transmitted through the bevel pinions and wheels then via the differential units to the axle shafts and road wheels.

A third differential unit, mounted on the input shaft of the first axle, provides differential action between the first and second axles.

Input torque from the vehicle transmission is transmitted to the splined inter-axle differential; at this point the drive is divided as follows:—

(i) A gear train which includes helical gears and differential pinions transmits the drive to the first rear axle reduction unit.

(ii) Drive is transmitted from the inter-axle differential spider to the through drive shaft then via the inter-axle propeller shaft to the second rear axle reduction unit.

The third differential is thus also used as a power distribution point for the two axles.

A differential lock is provided and consists of a sliding dog clutch which is splined to the through drive shaft and held in the dis-engaged position by a spring-loaded fork. When operated, it locks out the third differential, thus making a solid through drive

when travelling over bad surfaces where wheel spin is likely to occur (*see under "Vehicle Operating Instructions"*).

A filler plug is provided in the inter-axle differential casing for initial lubrication purposes only.

#### Features Common to all Types of Axles

The reduction gear unit is bolted to the axle casing and is removable as a unit.

Each hub is mounted on two taper roller bearings which are adjusted by means of shims and distance pieces.

Lubricant is retained in the hub by a lip-type seal, the brake shoes being kept clear of surplus lubricant by a grease guard riveted to the hub.

Fully floating axle shafts, having splined inner ends and integral flanges at their outer ends, transmit drive through the coupling flanges which are bolted to the wheel hubs.

A drain plug and combined filler and level plug is provided on the axle casing; a breather is fitted to the reduction casing.

Where a trailing, non-driving, second axle is fitted, the hubs and brake gear are similar to that previously described but they are carried on a plain straight tubular axle beam.

## Maintenance

At the periods quoted in the Routine Maintenance Programme, attend to the following:—

Lubricate the points detailed in the Lubrication Chart.

Examine the surplus escape hole in the hubs for signs of escaping lubricant. The appearance of lubricant at this point indicates that either too much lubricant has been applied to the hub bearings or that the seals need renewing (*see Part H of the Service Manual*).

Examine the flanged joints for signs of oil leakage and tighten if necessary; check also the oil seal on the pinion shaft for leakage. A possible cause of leakage from these locations can be attributed to a choked breather permitting excessive pressure to build up inside the casing.

Remove, clean and fit the breather; if further leakage is apparent from the pinion shaft oil seal, remove the seal and renew (*see Part H of the Service Manual*).

The hub bearings should only be lubricated at overhaul periods. Adjust the hub bearings if more than just a perceptible amount of "rock" is felt (*see Part H of the Service Manual*).

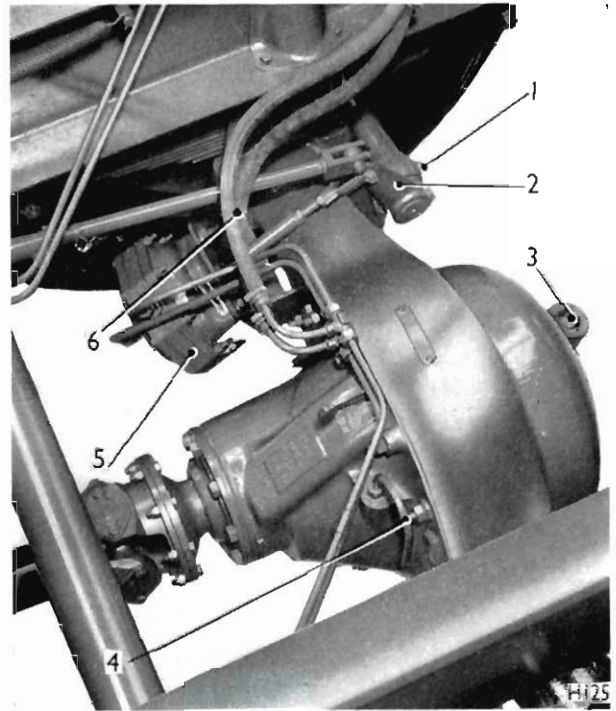
### Single Drive, Single or Double Reduction Axle

Top-up, or drain and refill, the axle with oil to the level of the filler plug hole. To drain the rear axle, remove the drain plug from beneath the axle casing.

### Double Drive, Single Reduction Axles

Top-up, or drain and refill with oil each axle casing to the level of their filler plug holes.

**Note.**—There is no separate drain plug for the inter-axle differential casing. It is preferable to drain the axles when the oil is still warm.



#### Key to Numbers:—

1. LUBRICATOR—OPERATING SHAFT
2. BRAKE OPERATING LEVER
3. OIL FILLER AND LEVEL PLUG
4. AXLE CASING BREATHER
5. MULTIPLE TYPE BRAKE AIR CHAMBER
6. FLEXIBLE AIR SUPPLY PIPES FOR BRAKE AIR CHAMBER

Fig. A12 Single drive, single reduction bevel axle

## Section 8

## SUSPENSION

(Refer to the manufacturer's manual for non-reactive type rear suspension)

### Description

Semi-elliptical, laminated steel springs are mounted between the axles and the chassis frame.

The front springs are mounted above the front axle beam and have resilient humpers pads fitted on top of them to restrict upward movement. Telescopic hydraulic dampers are fitted between the front axle and frame side members.

Where **Two Spring Suspension** is fitted to the rear axle (*see Fig. A12*) the springs are secured to the axle by bolts and are anchored at their ends by shackles and pins.

When "helper" springs are fitted to the rear suspension, they are located above the road springs and are provided as a secondary measure to limit excessive deflection. Thus, as load conditions impose sufficient deflection, the outer ends of the "helper" springs bear against the restraint brackets located on the frame members.

Where **Four Spring Suspension** is fitted to the rear axles (*see Fig. A13*), the rear springs are secured to the axles by special bolts, their ends being anchored to spring brackets and balance beams by shackles and pins.

Three point rear suspension is obtained by connecting the adjacent spring ends to a freely swinging balance beam, thus permitting free axle motion. The balance beams pivot in taper roller bearings. The shackle pins through the balance beam ends rotate in needle roller bearings.

Where **Fully Articulated Bogie Suspension** is fitted to the rear axles, the rear springs are clamped to the underside of a cradle pivoting on bushes on a tube attached to the chassis frame. The spring ends bear on spherical pads pressed into brackets on the rear axle casings.

The rear axles are located by resilient bushed torque

rods. The upper rods are fitted between the bogie crossmember and the tops of the axle reduction casings. The lower rods connect the bogie support brackets to the axle ends.

### Maintenance

At the periods quoted in the Routine Maintenance Programme, attend to the following:—

Lubricate the points detailed in the Lubrication Chart.

Check that the spring eyes are just free in their shackles and brackets.

If undue side play is present, take it up by fitting appropriate spacing washers on the pins.

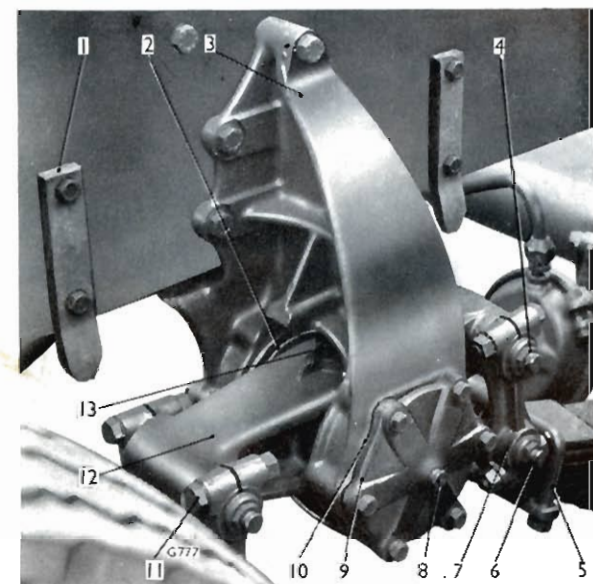
Inspect the bumper pads for deterioration.

On **Fully Articulated Bogie Rear Suspension**, check the bogie brackets, spring securing bolts and torque rod securing nuts for tightness. Visually examine the bonded-rubber bushed bearings in the torque rods for deterioration.

#### Key to Numbers:—

1. SPRING SHACKLE STOPS
2. SEAL COLLAR
3. BALANCE BEAM BRACKET
4. SHACKLE PIN LUBRICATOR ADAPTOR
5. SPRING CLIP
6. LUBRICATOR—SPRING SHACKLE PIN
7. SPRING SHACKLE
8. LUBRICATOR—BALANCE BEAM BEARINGS
9. BALANCE BEAM BEARING OUTER COVER
10. SHIMS
11. CLAMP BOLT
12. BALANCE BEAM
13. BALANCE BEAM DOWEL

Fig. A13 Balance beam and spring shackles



## Section 9

## BRAKING SYSTEM

### Description

The brakes are of the cam operated single leading shoe type.

The hand brake, which is of the direct pull-on variable leverage type, has air pressure assistance for its application. When it is held on the ratchet, the air supply is released from the brake chambers and the vehicle is held by the mechanical brake linkage.

Brake operation is by means of diaphragm type compressed air brake chambers which actuate the brake shoes through a lever and cam operated expander unit.

Front axle brake chambers are mounted over the swivel pins. Rear brake chambers are mounted on brackets welded to the rear axle casing.

On all wheels the brake shoes are returned to the "off" position by coil tension springs. Brake lining wear is compensated by an adjuster unit with a square ended adjusting stem and clicker spring (see Fig. A14).

The air supply for the brakes is filtered through an oil bath air cleaner and the pressure supplied by a twin cylinder air cooled compressor. The air compressor, is mounted on the engine and supplies compressed air to the frame mounted storage reservoirs.

The air pressure in the system is controlled by a line mounted unloader valve and protected by a safety valve. The safety valve, mounted in the compressor head, protects the system from excessive pressure rise should the unloader valve fail to operate at the correct pressure.

Low pressure indicators in the air system are connected electrically with an audible buzzer which is located in the driver's cab. The buzzer serves as a warning device and is operated when air pressure is below a safe minimum.

A load sensing valve may be fitted to automatically adjust the braking effort in relation to the vehicle loading.

### Load carrier vehicles

Air is supplied from the main reservoir via a brake valve to the foot brake side of the multiple diaphragm brake chambers. The hand brake side of the multiple diaphragm brake chambers, is supplied with air from a separate circuit using an auxiliary reservoir and control valve.

The hand brake, in addition to being a brake for parking, can if it is necessary, be used in an emergency to supplement the foot brakes.

When dual line braking is fitted, a similar system is employed except that the separate front and rear brake circuits are controlled by a dual brake valve; the air supply being stored in separate reservoirs.

On certain load carrier vehicles, brake operation is by means of single diaphragm type compressed air brake chambers.

Air is supplied from the main reservoir via a brake valve to the single diaphragm brake chambers on the front and rear axles.

The auxiliary reservoir supplies compressed air to the hand brake control valve which operates the same brake chambers as the footbrake on the rear axles. A change-over valve is incorporated in the system between the footbrake and hand brake service lines in order to isolate one system from the other.

Air supply for the differential lock and splitter gearbox systems is taken from the hand brake supply line.

### Tractor vehicle for semi-trailer

Separate circuits using multiple diaphragm brake chambers for the tractor and trailer brakes are controlled through the service lines by a dual foot brake valve. The trailer brakes are operated by the normal service and emergency lines.

An auxiliary brake circuit, which is controlled by a hand valve on the steering column, applies the brakes on the tractor front axle and through the auxiliary line to the trailer.

The air assisted hand brake operates a control valve supplying compressed air to the multiple diaphragm brake chambers fitted to the rear axle.

Air storage is by single and dual type reservoirs; the dual reservoir being divided into two chambers of different capacities.

The single storage reservoir is used to feed one half of the dual foot valve and supplies service braking on the tractor.

The smaller chamber of the dual reservoir has a multiple function because it supplies the trailer reservoir through the normal emergency line; the second half of the dual foot brake valve through the service line to the trailer brakes, and the power assisted hand brake. The larger chamber of the dual reservoir supplies the hand controlled auxiliary brake.

### Maintenance

At the periods quoted in the Routine Maintenance Programme, attend to the following:—

### Brakes

Lubricate all points detailed on the Lubrication Chart.

Check all brake fork ends and, if necessary, lubricate with oil.

The appearance of lubricant on the brake linings indicates that either too much lubricant has been applied to the hub bearings, or that the seals need renewing. The brake shoe linings must be either degreased or renewed.

### Air System

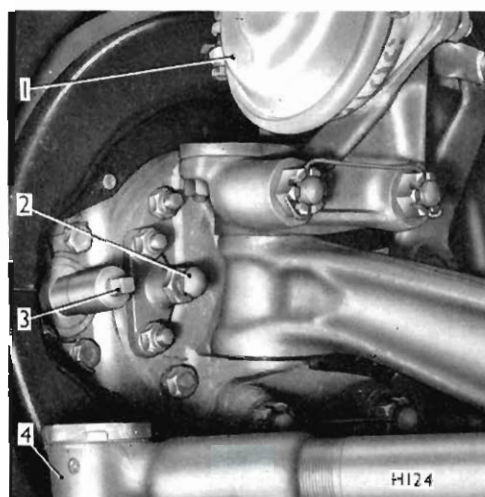
With the engine stopped and the foot brake pedal fully applied, check the main brake system for air leakage by observing the pressure gauge over a period of several minutes. A drop in pressure of approximately 10 lb. per sq. in. (0.7 kg. per sq. cm.) during the first 5 minutes, then a further drop of 20 lb. per sq. in. (1.4 kg. per sq. cm.) after 25 minutes is permissible. Check also, the air assisted hand brake and auxiliary hand control system by observing the auxiliary side of the pressure gauge. Any leakage in the brake lines, hoses or diaphragm brake chambers, will be noticeable by a pressure drop indicated by the air pressure gauge.

Parts suspected of leakage should be checked by applying a solution of soap and water; leakage may then be detected by the appearance of bubbles.

Any leakage from the safety valve port in the air compressor cylinder head will necessitate renewal.

Drain any condensate from the reservoirs by slowly unscrewing the plugs two turns. **The plugs, or drain cocks, must not be completely removed until the reservoirs have been completely exhausted of air.**

When refitting the drain plugs, test for leakage and, if necessary, renew the washers or plugs.



### Key to Numbers:—

- |                      |                         |
|----------------------|-------------------------|
| 1. BRAKE AIR CHAMBER | 3. BRAKE ADJUSTER       |
| 2. LOCK STOP         | 4. TRACK ROD SOCKET END |

Fig. A14 Brake adjuster—front axle

## Section 10

## COOLING SYSTEM

### Description

Engine cooling is effected by a resiliently mounted tube block type radiator, built up from sections of vertical tubes and horizontal gill plates sweated into the top and bottom tanks; a baffle in the top tank separates the inlet compartment from the outlet.

Coolant circulation through the system is maintained by an impeller type pump mounted at the front of the engine casing.

Pressure in the cooling system is regulated by a spring-loaded pressure and relief valve incorporated in the filler cap on the header tank. Any excess pressure in the system is vented to atmosphere via the vent pipe in the filler tube.

A thermostat fitted in the pipe connecting the engine coolant outlet to the radiator top tank, prevents coolant circulating through the radiator until a pre-determined temperature is reached. Thereafter the thermostat closes the by-pass allowing the coolant to flow to the radiator block.

Complete drainage of the cooling system is effected by a single drain cock which is fitted adjacent to the bottom left-hand side of the radiator. The cock is

coupled to the drain pipes from the radiator, and cab heater unit and when applicable, engine cylinder block.

A water temperature device is fitted in the system.

### Maintenance

Check the coolant level in the system daily; replenish if necessary (*for particulars see the para. "Before Starting the Engine" on page A9*).

Ensure that coolant is not leaking from any part of the radiator, hose connections or pipes. Occasionally check that the vent hole in the header tank filler tube is not obstructed.

Periodically wash the outer surface of the radiator tubes with a high pressure hose to remove dust and dirt, the presence of which reduces radiator efficiency.

At overhaul periods, remove the radiator (*see Section 19*) and flush out. Clean the radiator exterior before refitting.

Refer to the paragraph "**Frost Precautions**" on Page A12 and also to Section 18.

Owing to its construction, the radiator cannot be dismantled and no attempt should be made to do so.

## Section 11

## SILENCER

### Description

The silencer is of the tube and vane type.

It is divided into two compartments and has one inlet, one internal tube, and four outer tubes. The compartment at the outlet end incorporates two

internal chambers fitted between a cylindrical vane assembly.

There are no cleaning plugs or doors.

### Maintenance

No routine maintenance is necessary.

## Section 12

## FUEL SYSTEM

### Description

Fuel oil is drawn from the supply tank by a lift pump.

The delivery from the lift pump passes through the main "bowl-less" fuel filter, which is of the paper element type, to the inlet fuel filter contained within the injection pump; when fitted, a bowl-less type fuel sedimenter is incorporated in the fuel line.

A fine gauze filter disc is also fitted in each injector for final filtering purposes. Back leakage (or dribble)

### Key to Numbers:—

1. PERMANENT BLEED PIPE
2. INJECTOR DRIBBLE GALLERY PIPE
3. AIR VENT
4. RETAINING BOLT
5. OUTLET PIPE TO FUEL-INJECTION PUMP
6. NON-RETURN VALVE—EXCESS FUEL FROM PUMP
7. FILTER ELEMENT
8. FILTER BASE
9. FUEL INLET FROM LIFT PUMP
10. FUEL LIFT PUMP

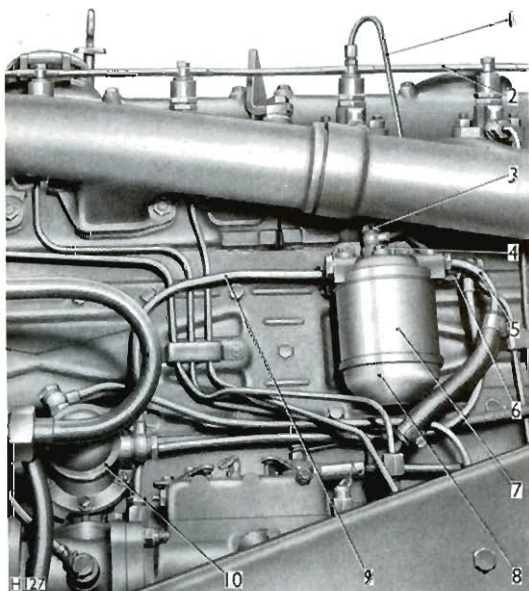


Fig. A15 Bowl-less type fuel filter and piping

from the injectors is piped to a gallery pipe and returned to the supply tank.

A drain plug is fitted in the base of the fuel tank and a magnetic type fuel gauge is incorporated in the side of the tank.

### Maintenance

At periods quoted in the Routine Maintenance Programme, attend to the following:—

Check all fuel pipes for security and leakage.

### Fuel Filter

Place a suitable receptacle under the filter to drain the fuel oil.

Unscrew the retaining bolt in the filter head and detach the element and filter base.

Remove the sealing rings located in the filter head and the sealing ring in the filter base. Wash the base portion and see that it is free from sludge.

Renew both the element and sealing rings.

Fit the sealing rings, making sure that they are properly located, and assemble the element to the filter head with the strengthened rim uppermost.

Attach the filter base to the element and secure with the retaining bolt.

### Fuel Sedimenter (when fitted)

Release the drain plug at the base of the sedimenter and drain off the separated water, no other maintenance is necessary, unless accumulated solid material blocks the drain passages, the unit should then be dismantled and cleaned. The water in the sedimenter must not be allowed to rise above the top of the transparent base.

### To Vent the Fuel System

With the engine running at idling speed, slacken the air vent plug(s) in the filter cover sufficiently to allow the fuel to seep out; close the air vent plug(s) when the air bubbles cease to appear.

If, after checking, the engine does not accelerate rapidly and without hesitation, slacken off each fuel delivery pipe in turn at the injector end. Allow sufficient fuel to seep out whilst watching for air bubbles between the pipe and the union nut; when free of bubbles, tighten the union nut.

## Section 13

## ELECTRICAL EQUIPMENT

This vehicle is wired on the double pole (insulated return) system, which gives maximum protection to the wiring and electrical units.

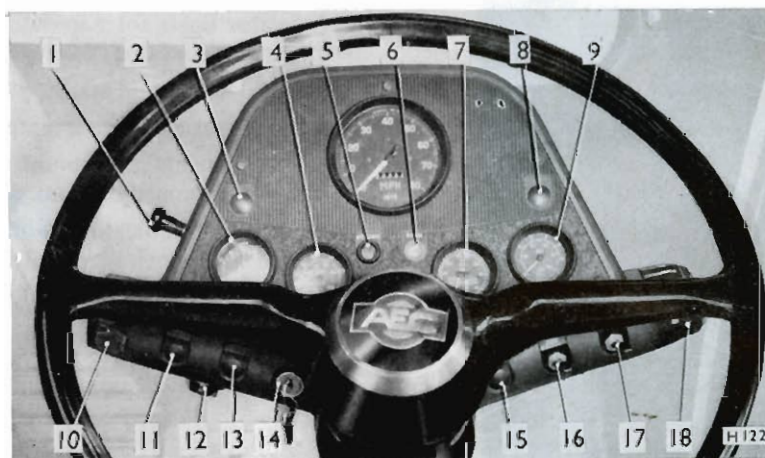
To retain this advantage, on no account must any additional equipment using the single pole (earth return) system be fitted.

### Description

The chassis is wired on the 24 v. insulated return system and where necessary the cables are enclosed in

oil resistant plastic tubing; the cable entries are through tight fitting rubber bushes and glands.

All equipment supplied with the chassis is included



### Key to Numbers:—

1. DIMMER SWITCH FOR PANEL LIGHTS
2. AMMETER
3. LOCATION FOR ADDITIONAL WARNING INDICATOR LIGHT
4. WATER TEMPERATURE GAUGE
5. ALTERNATOR CHARGING INDICATOR LIGHT
6. HEAD LAMP MAIN BEAM INDICATOR LIGHT

7. AIR PRESSURE GAUGE
8. LOCATION FOR ADDITIONAL WARNING INDICATOR LIGHT
9. OIL PRESSURE GAUGE
10. DIRECTION INDICATOR SWITCH
11. LOCATION FOR LEFT-HAND FOG LAMP SWITCH
12. STARTER PUSH BUTTON

13. LOCATION FOR RIGHT-HAND FOG LAMP SWITCH
14. "START" SWITCH
15. LOCATION FOR ADDITIONAL LIGHTING SWITCH
16. SIDE AND TAIL LAMP SWITCH
17. HEAD LAMP SWITCH
18. HORN PUSH

Fig. A16 Instrument panel

on the wiring diagram but detailed servicing instructions relating to certain items supplied by bodybuilders, such as direction indicators, etc., are not covered.

**Note.**—All electrical connections and cable entries are externally protected by a special sprayed-on sealant. This sealant can be removed by a suitable spirit solvent.

When reconnecting, the sealant, which is non-conducting, must NOT be deposited on any contact points.

Supplies of this sealant can be obtained from any Depot or Agent of AEC.

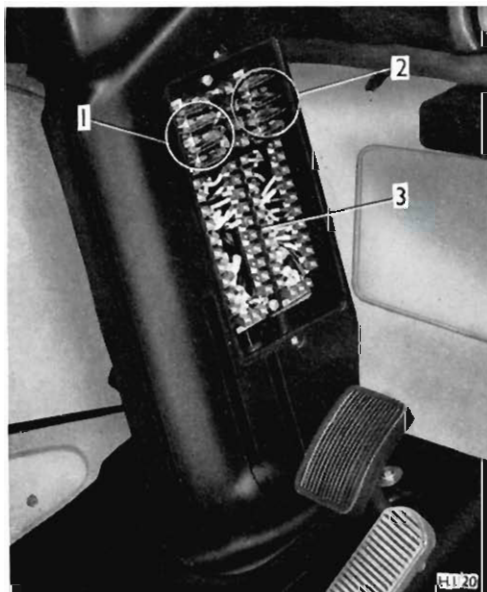
Electrical supply is from a 24 v. battery comprising of two 12 volt units connected in series.

A battery isolating switch (when fitted) is mounted beneath the battery box. Note that the switch is **not** a circuit breaker; therefore all other switches on the chassis should be opened before it is operated.

Battery charging is by the alternator, the output being controlled by a regulator unit which is fitted to the panel mounted on the floor at the rear of the driver's seat. The voltage output from the regulator is governed by three separate and different adjustments.

The pedestal below the instrument binnacle houses all the wiring and fuses in an easily accessible position. Cab wiring is connected to the main chassis loom by a soap-connected multi-pin plug.

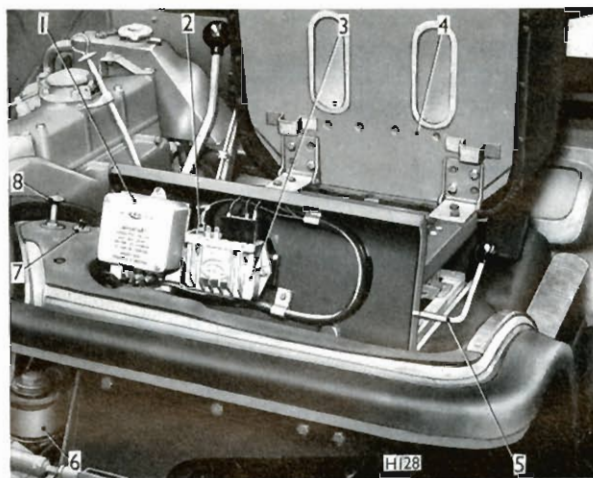
The instruments and subsidiary controls are mounted forward of the steering column.



**Key to Numbers:—**

1. LOCATION OF AUXILIARY FUSES
2. LOCATION OF LAMP FUSES
3. FUSE AND DISTRIBUTION PANEL

**Fig. A17 Fuse and distribution panel**



**Key to Numbers:—**

- |  |  |
|--|--|
| 1. FLASHER UNIT                                    | 5. LEVER—SEAT LOCK                     |
| 2. TERMINAL CONNECTOR—<br>VARIABLE VOLTAGE SETTING | 6. HYDRAULIC SUPPLY TANK —<br>CLUTCH   |
| 3. REGULATOR UNIT                                  | 7. "DIFF" LOCK BUTTON<br>(WHEN FITTED) |
| 4. DRIVER'S SEAT (TILTED<br>FORWARD)               | 8. ENGINE STOP CONTROL                 |

**Fig. A18 Flasher and regulator units**

The fuse and distribution panel mounted in the side of the pedestal houses the :—

Lamp and auxiliary circuit fuses.

All necessary terminals.

The instrument panel and binnacle incorporates:—

Speedometer with distance recorder, ammeter, oil pressure, air pressure and water temperature gauges.

Indicator lights for alternator and head lamp main beam and when fitted, water temperature.

"Start" switch and starter push button.

Switches for all driving lamps including fog lamp.

All instruments are illuminated by a panel lighting switch with dimmer rheostat control.

A direction indicator switch and horn push are mounted at opposite ends of the binnacle; the head lamp dip switch is located on the cab floor adjacent to the clutch pedal.

The axial type starter motor is operated by a built-in-solenoid switch controlled by the starter push button.

## Maintenance

### Fuses

**Lamp and Auxiliary** 10 amp. safe current 27 S.W.G. wire.

To gain access to these fuses remove the cover from the side of the instrument pedestal, where spare fuses will be found wound around the fuse bridges on the distribution panel.

Never use more than one strand of wire for each fuse and never alter the size, gauge or material of the wire.

### Lamp Bulbs

Head (double filament)	24 volt, 44/38 watt, L.H. dip (R.H. Chassis Home and Overseas) double contact pre-focus. 24 volt, 50/50 watt, Unified European Hooded dip (Overseas-Europe only) 3 lug.
Side and Tail . . . . .	24/28 volt, 6 watt, double contact S.B.C.
Stop and Flasher . . . . .	24 volt, 24 watt, double contact S.B.C.
Cab Interior . . . . .	24 volt, 6 watt, double contact festoon.
Panel and Warning Lights . . . . .	} 24 volt, 2.8 watt, single contact M.E.S.

*For further particulars of fuses and lamps see Part O of the Service Manual.*

### Battery

At the periods quoted in the Routine Maintenance Programme, the batteries should receive attention as follows:—

If a battery becomes fully discharged, remove it from the vehicle and fully re-charge it on the bench. Attempts to charge the battery by the alternator on the

vehicle will be unsuccessful and the battery will not reach a satisfactory state of charge.

Brush any dirt from the top of the battery and remove the vent plugs. **ON NO ACCOUNT BRING A NAKED LIGHT NEAR WHEN THE VENT PLUGS ARE REMOVED, OR WHEN THE BATTERY IS BEING CHARGED, AS THE GAS GIVEN OFF BY THE ELECTROLYTE IS EXPLOSIVE.**

### Vent Plugs

These must be clean and their air passages free.

### Cable Terminals

These must be free from corrosion, bolted tightly on the battery terminal posts and coated with petroleum jelly—**not grease**. If corrosion has taken place, disconnect the terminal from the battery, scrape the corrosion away, taking care that none of it gets into the cells, and wipe clean with a rag moistened with weak ammonia or bicarbonate of soda solution.

### Topping-up

The cells should be examined and topped-up at regular intervals, so that the level of the electrolyte is  $\frac{1}{4}$  in. (6 mm.) above the top of the separators. Always ensure that the tops of the batteries are kept clean and dry.

### Do not overfill.

**NEVER EMPTY ELECTROLYTE FROM THE BATTERY.**

## Section 14

## PEDAL GEAR

### Description

The pedal gear bracket is bolted to the chassis frame at the rear of the steering box.

The organ type accelerator pedal is pivot mounted from a heel block on the driver's floor plate and is connected by a spherical joint and rod to a pedal bracket using a system of cross shafts and levers to the fuel-injection pump operating lever. Incorporated in the linkage is a spring loaded over-ride which protects the fuel-injection pump operating lever from excessive load. A return spring is provided at the throttle end of the linkage.

The clutch and brake pedals are made in two sections, the upper portions are adjustable and carry the

foot pads, the lower sections are pivot mounted in the pedal gear bracket. Push rods connected by a fork end to the pedal arms operate the brake valve and clutch hydraulic master cylinder attached to the rear of the pedal bracket. A pedal return spring is fitted to each push rod.

Draught excluders are fitted to all the pedals.

### Maintenance

Lubricate all points detailed in the lubrication chart. Fork ends, locknuts and clevis pins should be checked for tightness at lubrication periods.

Instructions for setting the accelerator pedal in relation to the fuel-injection pump operating lever are given in Parts B and R of the Service Manual.

## Section 15

## CAB AND TILT MECHANISM

## Description

The cab is an independent unit on a four point rubber suspension and is pivoted on its front mountings. Cab weight is counter-balanced by a torsion bar which is connected through a short torque arm and adjustable link to the tilt beam. When the cab is tilted the driver's floor, instrument panel and steering column remain fixed in position on the chassis.

**On early vehicles,** twin stirrups on the rear of the cab sub-frame make positive engagement with the holding down locks on the chassis frame, the locks being connected by a manually operated transverse lever which is locked by a safety catch and key (see Fig. A3). Alternatively, certain vehicles are fitted with a modified cab lockdown mechanism. This can be identified by a striking lug clamped to the operating handle, a safety hook, stop plate welded to the crossmember and a washer welded on the end of both lockdown hooks.

**On late vehicles,** the cab locking is by means of clamping rings and lock screws which are tightened against the bosses on the cab arch crossmember (see Fig. A4).

## Hydraulic Tilt (when fitted)

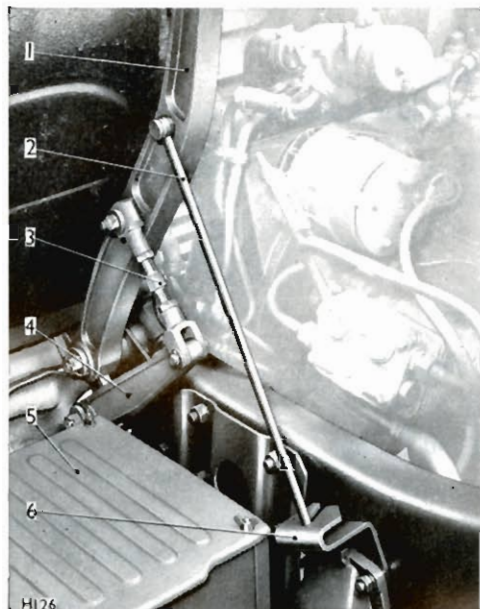
The cab is tilted by means of a hydraulic double-acting ram attached to the tilt beam at its top end and secured to a bracket on the frame at its lower end.

Pressure is supplied to either end of the ram by a two-position hand operated hydraulic pump, mounted on the frame (see also "Vehicle Operating Instructions").

The pump incorporates an oil reservoir; a filler plug is provided in the top of the pump and a level plug is fitted in the side of the pump.

Compressed air windscreen wipers are housed over the windscreen and are operated by a switch over the driver's side of the screen.

The heater unit is built into the lower windscreen rail and provides demisting and defrosting on both



## Key to Numbers:—

- |                    |                        |
|--------------------|------------------------|
| 1. TILT BEAM       | 4. TORQUE REACTION ARM |
| 2. SAFETY STAY     | 5. BATTERY COVER       |
| 3. TURNBUCKLE LINK | 6. CATCH PLATE         |

Fig. A19 Cab tilt mechanism

the windscreen and door quarter lights. The heating and fresh air ventilation ducts cover the width of the windscreen and extend into both sides of the cab; manually operated flaps are fitted to control the air flow.

## Maintenance

No routine maintenance is necessary other than the occasional greasing of movable parts on the cab locking gear. Check the fork ends, clevis pins and locknuts for security.

## Section 16

## TYRES AND WHEELS

**Warning.**—Speed restrictions which vary from country to country and with the type of operation, are imposed upon the use of some varieties of tyre equipment. AEC vehicles supplied in the U.K. are normally fitted as original equipment, with standard first tread radial steel cord tyres which may be used up to a sustained speed of 60 m.p.h. in the U.K.

For operation overseas or at higher speeds and for details of any limitations imposed on the use of other types of tyre, reference should be made to the tyre manufacturer concerned.

Tyres must be kept inflated to their correct pressure. The pressures shown correspond to the **tyre manufacturers recommended figures, in their Load-Inflation Schedules**, which show the correct pressure for any particular tyre loading.

These loadings should be checked by weighing a loaded vehicle.

Operations on motorways or continuous high speeds may require special tyres and attention to tyre equipment.

## Recommended Maximum Pressures:—

- |                               |                        |
|-------------------------------|------------------------|
| 9-00-20 radial steel cord . . | 100lb. per sq. in.     |
|                               | (7.0 kg. per sq. cm.). |

10.00-20 high load radial	
steel cord .. .. .	105 lb. per sq. in. (7.4 kg. per sq. cm.).
11.00-20 high load radial	
steel cord .. .. .	115 lb. per sq. in. (8.1 kg. per sq. cm.).

A tyre running hot is evidence of pressure being too low rather than too high.

For unusual or "off the road" work refer to the tyre manufacturer.

Lack of common care when driving, excessive speed, fierce acceleration and braking all contribute to shortening tyre life. These practices should never be used except in an emergency.

Tyre life can be considerably extended by attending to the following maintenance items.

- (i) Toe-in—Check (see Part G).
- (ii) Wheel bearings—Check for slackness (see Parts G and H).
- (iii) Brakes—Check for equal operation (see Part K).
- (iv) Clutch—Check for correct engagement (see Part C).
- (v) Tyre pressure—Check with gauge (including the spare wheel).
- (vi) Keep tyres free from oil, grease, paraffin and embedded matter.

**Note.**—The foregoing references apply to Parts of the Service Manual.

## Wheels

### To Remove

Remove the wheel nut guard (when fitted).

Slacken the wheel nuts. Note that the left-hand side nuts have left-hand threads and the right-hand side nuts have right-hand threads.

Jack up the axle until the wheel is clear of the ground, complete the removal of the nuts and lift off the wheel, taking care not to lose the ferrules that fit between the brake drum and road wheel.

### To Fit

Fit the ferrules to each wheel stud, with the tapered side facing the wheel.

Mount the wheel on the wheel studs ensuring that, in the case of twin wheels, the appropriate four holes in the wheel disc are aligned opposite the four set-screws which secure the brake drum to the hub.

Ensure that the tyre valves of twin wheels are located at 180° the one to the other.

With the wheel jacked up clear of the ground, start the wheel nuts. Give the nuts a preliminary tightening, operating **progressively and diagonally** across the wheel (see Fig. A20).

Lower the wheel and complete the tightening of the wheel nuts still employing a **diagonal** sequence.

It is very important to adhere to this procedure when mounting twin wheels; it is extremely bad practice to fully tighten one wheel nut before tightening the others.

Most cases of wheel looseness arise from this cause, as the discs are forced so closely in contact that they cannot move relative to each other and seat themselves correctly on the wheel stud tapers when the remaining nuts are tightened.

After fitting the wheel, ensure that the tyre valve is clear of the brake drum. If it is not, bend it very gently with a suitable lever until it is clear.

On new vehicles, or when a wheel has been changed, the wheel nuts should be tightened **daily** until it is found that the wheel has "bedded" down.



Fig. A20 Sequence of tightening wheel nuts

## Section 17

## LUBRICATION

The standard method of chassis lubrication for the main units is by filler and level plugs and by pressure gun to individual lubricators for the remaining points.

The location of all lubricators and type of lubricant required are indicated on the Lubrication Chart at

the end of the book (see also *Chassis Data and Part S of the Service Manual*).

Where an automatic lubrication system is fitted, whether it be belt driven or air operated in conjunction with the chassis braking system, refer to Supplement to Part S of the Service Manual.

## Section 18

## ANTI-FREEZE MIXTURE

**Engine Coolant**

A good quality anti-freeze solution should be used, conforming to British Standard Specification 3151, Type B or 3152, Type C. The dilutions should be as recommended by the manufacturers of the solution.

Before filling the cooling system with the anti-freeze mixture, drain it completely by opening the drain cock provided, then thoroughly flush out and circulate clean water several times through the system. Because of the penetrating properties of the mixture, check all joints in the cooling system for tightness, any leakage of the mixture into the engine may cause serious damage.

Fill the cooling system with the mixture to the level stated in "**Vehicle Operating Instructions**". A notice should be placed in a prominent position to the effect that the system is filled with anti-freeze mixture.

The anti-freeze mixture may be retained in the cooling system for twelve months, but it must be renewed at the commencement of each winter.

It is preferable, however, that the anti-freeze mixture should be drained and discarded at the end of the winter season, the system flushed with clean water and refilled with corrosion inhibited water for the summer period.

This procedure ensures that the system is protected against corrosion both summer and winter.

While it is not recommended that anti-freeze mixture is replaced by plain water, if this is unavoidable

it is important to flush out the system thoroughly before changing over.

**Air Pressure System**

In cold weather the reservoir of the anti-freezer (when fitted) should be filled to the level of the filler neck as instructed on the container with Mineralised Methylated Spirit, Ethyl Alcohol or METHYL ALCOHOL; best results will be obtained with the latter. Methyl Alcohol can be obtained from methylators under the name of "Blending Methanol" or "I.M.S. Substitute", both 74 per cent. overproof. The capacity of the reservoir is approximately  $\frac{1}{2}$  Imperial pint (280 cc.).

**Note:—These agents are toxic in both the liquid and vapour state and have a very low flash point. The following precautions should therefore be observed:—**

**Do not fill the anti-freezer in an enclosed space, unless a good and free circulation of air is available.**

**The use of naked lights and smoking must be strictly forbidden.**

All alcohol contains a small percentage of water which does not evaporate as quickly as the alcohol and therefore as the alcohol is consumed, the percentage of water increases, thus decreasing the efficiency of the anti-freezer. To prevent the water content reaching too high a value it is, therefore, advisable to run the anti-freezer until it requires refilling and drain away the residual alcohol and water by removing the drain plug, rather than to keep topping up the anti-freezer with fresh alcohol.

**NOTES**

A32D

## NOTES

## REMOVAL AND FITTING OF MAJOR UNITS

	<i>Section</i>
Radiator .. .. .	19
Engine .. .. .	20
Clutch .. .. .	21
Gearbox .. .. .	22
Steering .. .. .	23
Front Axle .. .. .	24
Rear Axles .. .. .	25
Cab and Tilt Mechanism .. .. .	<i>See Part Y</i>

**All Fuel, Lubrication and Air Pressure Pipes, after removal, must have their ends plugged or taped over to prevent the ingress of dirt. For Minor Units and Sub-units see the appropriate Part of the Service Manual.**

**IMPORTANT—ISOLATE THE BATTERIES BEFORE COMMENCING TO SERVICE ANY UNIT.**

**WARNING—REMOVAL OF THE TILT CAB SHOULD NOT BE UNDERTAKEN UNLESS THE TENSION ON THE TILT BEAM IS HELD BY A SUITABLE “U” BOLT AND CLAMPED TO THE CHASSIS FRAME.**

## Section 19

## RADIATOR

### To Remove

Drain the coolant from the system by opening the drain cock(s) adjacent to the bottom left-hand side of the radiator and (when fitted) on the engine cylinder block.

**Note.** If anti-freeze mixture is in use, collect the coolant in suitable containers.

Disconnect the drain cock(s) from its/their mounting bracket at the base of the radiator or disconnect the pipes from the drain cock(s).

Tilt the cab forward (*see Vehicle Operating Instructions*).

Remove the fan from the engine crankshaft damper

and place the fan inside the radiator cowl.

Slacken the hose clips securing the radiator inlet and outlet hose connections and remove the heater pipe clip connection from the radiator.

Remove the bolts securing the radiator mountings to the chassis frame, lever the hose connections free and lift off the radiator.

### To Fit

Reverse the procedure detailed above. Examine the water hoses to ensure that they are in good condition.

Refill the radiator with coolant and examine the radiator and hoses for possible leakage.

## Section 20

## ENGINE

### To Remove

Remove the radiator (*see Section 19*).

Disconnect the air compressor delivery pipe.

Disconnect the rubber hose connection from the oil pressure gauge pipe.

Detach the exhaust pipe from the exhaust manifold.

Disconnect the alternator and starter cables.

Unscrew the pipe unions and remove the inlet pipe from the fuel-lift pump and the excess fuel return at the pipe connection.

Disconnect the water temperature gauge connection element from the rear cylinder head and disconnect the capillary from the air intake.

Disconnect the throttle control rod at the pedal arm and the cross shaft.

Detach the muff coupling at the change speed shaft and remove the change speed box from the side of the engine.

Disconnect the flexible pipes from the power assisted steering pump and supply tank.

Disconnect the water drain pipe from the rear, near side of the engine casing.

Remove the gearbox (*see Section 22*).

Disconnect the engine stop control cable from the driver's floor plate.

Using the lifting bracket between the cylinder heads, support the weight of the engine on a suitable garage crane.

Remove the bolts securing the engine mountings to the front crossmember followed by the two rear mounting bolts.

Lift the engine as high as possible and withdraw slowly, whilst raising the rear portion of the engine to allow it to clear the rear mountings.

### To Fit

Reverse the procedure for removal ensuring that all hoses are in good condition. Note that, when changing an engine or a fuel-injection pump, it may be necessary to adjust the operating rod to ensure correct travel of the pump throttle lever.

Fit the gearbox (*see Section 22*).

Ensure that the gearbox primary shaft spigot enters the bearing housing and that the clutch operating levers locate correctly in the clutch withdrawal housing.

## Section 21

## CLUTCH

### To Remove

Remove the gearbox from the vehicle (*see Section 22*); the clutch withdrawal bearing assembly will come away on the primary shaft.

Remove the clutch cover plate by slackening the securing setbolts a little at a time, thus releasing gradually the clutch pressure springs.

Lift the complete assembly away from the flywheel; the driven plate can then be removed.

### To Fit

Ensure that the primary shaft bearing is greased and fitted in the housing at the end of the crankshaft (*see Part D of the Service Manual*).

Lightly smear with grease the driven plate hub splines. Care must be taken not to allow any grease to contact the driven plate facings.

Fit the driven plate to the flywheel with the flange on the driven plate centre towards the gearbox.

Pass the mandrel portion of the tool listed in the Maintenance Equipment through the splined hub of the driven plate and insert the small end into the pilot bearing in the crankshaft. Ensure that the shoulder of

the tool butts against the pilot bearing.

Fit the cover plate assembly complete making sure that the dowel on the engine flywheel enters its hole in the cover plate and tighten the setbolts a turn at a time, by diagonal selection until the cover assembly is firmly secured against the flywheel.

Remove the mandrel, thus leaving the driven plate correctly centred.

Fit the gearbox (*see Section 22*).

## Section 22

### GEARBOX

#### To Remove

Remove the gearbox trap or metal flooring from the body floor (when fitted) and place a suitable tripod or tackle in position.

Disconnect the universal joint from its coupling flange on the gearbox and tie up the propeller shaft to some convenient point on the chassis to prevent damage.

If a propeller shaft intermediate bearing is fitted, remove two of the intermediate bearing bracket bolts to enable the propeller shaft to be moved to one side of the gearbox.

Disconnect the power take-off output shaft (when fitted) at its coupling flange.

Disconnect the speedometer cable from the gearbox.

Disconnect the change speed shaft at the rear muff coupling.

Remove the return spring from the push rod and disconnect the hydraulic cylinder bracket complete with hydraulic cylinder from the gearbox. Remove the fork end pin from the clutch operating lever; do not disconnect the hydraulic pipe connection or the system will require bleeding.

When a splitter type gearbox is fitted, release the air from the system and disconnect the pipes from the box air cylinder. Release the cylinder push rod from the

selector yoke lever by withdrawing the pin from the fork-end; remove the trunnion pin securing the base of the cylinder to the bracket and remove the cylinder.

Take the weight of the gearbox and remove the securing nuts from the bell housing.

Disconnect the front and rear silencer support brackets from the gearbox.

Withdraw the gearbox from the engine to disengage the primary shaft from its pilot bearing, then lower the gearbox onto a suitable trolley and withdraw from beneath the vehicle.

#### To Fit

Reverse the procedure for removal, ensuring that the change-speed shaft is correctly coupled up in relation to the change-speed lever, and that the selector levers obtain all the gears in the box. Ensure that the gearbox primary shaft spigot enters the bearing housing and that the clutch operating levers locate correctly in the clutch withdrawal housing.

When applicable, check that the sleeve on the change-speed lever shaft is secured in its correct position to operate the air control valve for the splitter type gearbox; fit the pipes to the air cylinder, start the engine and check for air leaks and finally, ensure that all systems function correctly.

## Section 23

### STEERING GEAR

#### To Remove

Remove the upper sections of the brake and clutch pedals and the accelerator pedal link; then remove the rubber floor surround.

Tilt the cab (*see Vehicle Operating Instructions*).

Prise the dust cap out of the steering wheel centre with a screwdriver; remove the retaining nut and, when fitted, the washer from the shaft and lift off the steering wheel.

Remove the support from the rear of the instrument binnacle.

Disconnect the dip switch. Unbolt the floor support crossmember in front of the steering box and dis-

connect the clips securing the main loom to the chassis member.

Disconnect the "diff" lock button, when fitted, and engine stop control. Remove the screws from the base of the pedestal and tie the instrument binnacle to the cab to give it support. Unbolt the forward section of the driver's floor plate and remove the plate with the draught strip and retaining plate.

Remove the fuse panel cover from the pedestal and free the wiring by removing the setscrews and ferrules.

Remove the front and rear mounting bolts from the drivers' floor and raise the floor sufficiently to gain access to the steering drop arm.

Remove the steering drop arm by removing the nut and drawing the arm off its splines with the tool listed in the Maintenance Equipment.

Remove the clutch and brake pedal stop brackets being careful to note their positions relative to the pedal bracket.

Disconnect the fork end pin from the brake valve push rod; disengage the brake pedal from the rod.

Mark the lever position in relation to the splines, then slacken the clamp bolt and remove the lever from the cross shaft.

Prior to removing the steering box and cross-member securing bolts support the weight of the engine by inserting suitable packing and a lifting jack under the first crossmember.

To obtain access to the top rear steering box securing bolt, slacken the bleed screw on the clutch hydraulic slave cylinder and depress the clutch pedal lever to its fullest extent; the nut and bolt may then be removed. Tighten the bleed screw on the next clutch compression stroke.

Support the weight of the steering box before removing the remaining securing bolts, then lower the box to the ground, ensuring that the top of the column is allowed to pass through the instrument pedestal without hindrance from the wiring.

### To Fit

#### Manual and Power Assisted Steering

Reverse the procedure for removal noting the following points:—

To ensure that the drop arm is fitted in the mid-position, turn the steering wheel on to the full right-hand lock, fit the drop arm on to the splined rocker shaft so that the centre of the ball pin hole is between  $6\frac{1}{4}$  in. and  $6\frac{7}{8}$  in. (158.8 mm. and 174.6 mm.) from the vertical, with a bias towards the front of the vehicle.

For adjustment of the steering linkage (*see Part F of the Service Manual*).

When fitting the steering wheel, make sure that the spokes are in the horizontal position when the road wheels are in the straight ahead position.

Fit the tab washer and drop arm securing nut.

## Section 24

### FRONT AXLE

#### To Remove

Apply the hand brake, and chock the rear wheels in front and behind.

Slacken the front wheel nuts.

Jack up the **frame** immediately behind the front springs to take the weight off the front springs.

Drain the air pressure system (*see Section 9*).

Disconnect the flexible air pipes from the front brake air chambers.

Detach the steering drag link by removing the nut which holds the ball stud into the swivel lever and press out the ball stud with the tool listed in the Maintenance Equipment.

Release the hydraulic dampers from the brackets on the frame and axle.

Remove the road spring securing bolt nuts and drive up the bolts clear of the axle beam.

Support the axle on jacks and remove the road wheels.

Lower the axle on to a wheeled trolley and remove from beneath the vehicle.

#### To Fit

Reverse the procedure for removal ensuring that the track rod and lock stop settings are checked in accordance with the instructions contained in Section 6 and Part G of the Service Manual.

Ensure that the flexible air pipes to the front brake air chambers are in good condition and adequately fastened.

Ensure that the tapered ends of all ball studs and their mating faces are clean before assembly.

## Section 25

### REAR AXLE(S)

(Two or four spring suspension)

#### To Remove

Scotch the front wheels in front and behind.

Jack up the frame in front of the axle, until the weight is taken off the springs; support the frame on wooden packings.

Disconnect the automatic lubrication pipes (when fitted).

Disconnect the hand brake operating rods from the brake camshaft levers and secure to some convenient point on the chassis.

Drain the air pressure system (*see Section 9*).

Disconnect the flexible air pressure pipes to the air chambers also the air pipe to the third differential lock selector casing (when fitted).

Disconnect the propeller shaft rear universal joint from its coupling flange. Similarly on vehicles fitted with two-axle drive, disconnect the inter-axle universal joints from their couplings; secure the shaft(s) to some convenient point to prevent damage.

Support the axle on jacks and remove the road wheels.

Remove the spring pin and lower shackle pins from each road spring.

Lower the axle on to a suitable trolley and remove from beneath the vehicle.

#### To Fit

Reverse the procedure for removal, noting the following points. Connect up the hand brake operating rods to the camshaft levers and do **not** alter the lengths of the rods.

Ensure that the flexible air supply pipes are in good condition and adequately fastened.

### (Articulated suspension)

#### To Remove

Scotch the front wheels both in front and behind.

Jack up the frame under the bogie crossmember to take the weight off the spring.

Remove the fork end pins and disconnect the brake rods from the brake operating levers.

Drain the air pressure system (*see Section 9*) and disconnect the flexible air pressure pipes.

Disconnect the automatic lubrication pipes (when fitted).

Disconnect the input and intermediate propeller shaft yoke flanges at the universal joints; secure the input shaft to a convenient point, to prevent damage to the universal joints.

Disconnect the upper torque rods from the axle casings.

Disconnect the lower torque rod pivot brackets from the axle casing.

Raise the frame sufficiently high enough to clear the axle casings.

Using a suitable bar to keep the axle reduction casing in an upright position, wheel each axle assembly away from its spring location and clear of the vehicle.

#### To Fit

Reverse the procedure for removal noting the following points:—

The upper torque rods should be bolted to their brackets on the frame crossmember. The taper pins in the lower torque rods should be left slack in their anchorage holes on the bogie support brackets.

Wheel the 1st driving axle casing into position keeping the reduction casing in an upright position with suitable levers.

Lower the frame until the leading end of the spring lines up with the spring brackets on the axle casing.

Push the 1st driving axle rearwards to engage the springs and line up the axle so that the lower torque rods can be located in their brackets on the underside of the axle. Fit the torque rod locating bolts.

Jack up, or with suitable lifting gear, raise the 2nd driving axle sufficiently to facilitate the fitting of the bolts between the upper torque rod and axle casing. This will stabilize the 1st driving axle and prevent forward movement away from the springs during the fitting of the 2nd driving axle.

Tighten the upper torque rod.

Fit the 2nd driving axle using the same procedure as previously described.

When both axles are connected to the torque rods, jack up the axles independently, one end at a time, so that the lower rods assume a position parallel with the frame. Tighten each torque rod when this position is obtained (*see Part J*).

## NOTES

NOTES

## NOTES

# PART B44

# B44

# ENGINE

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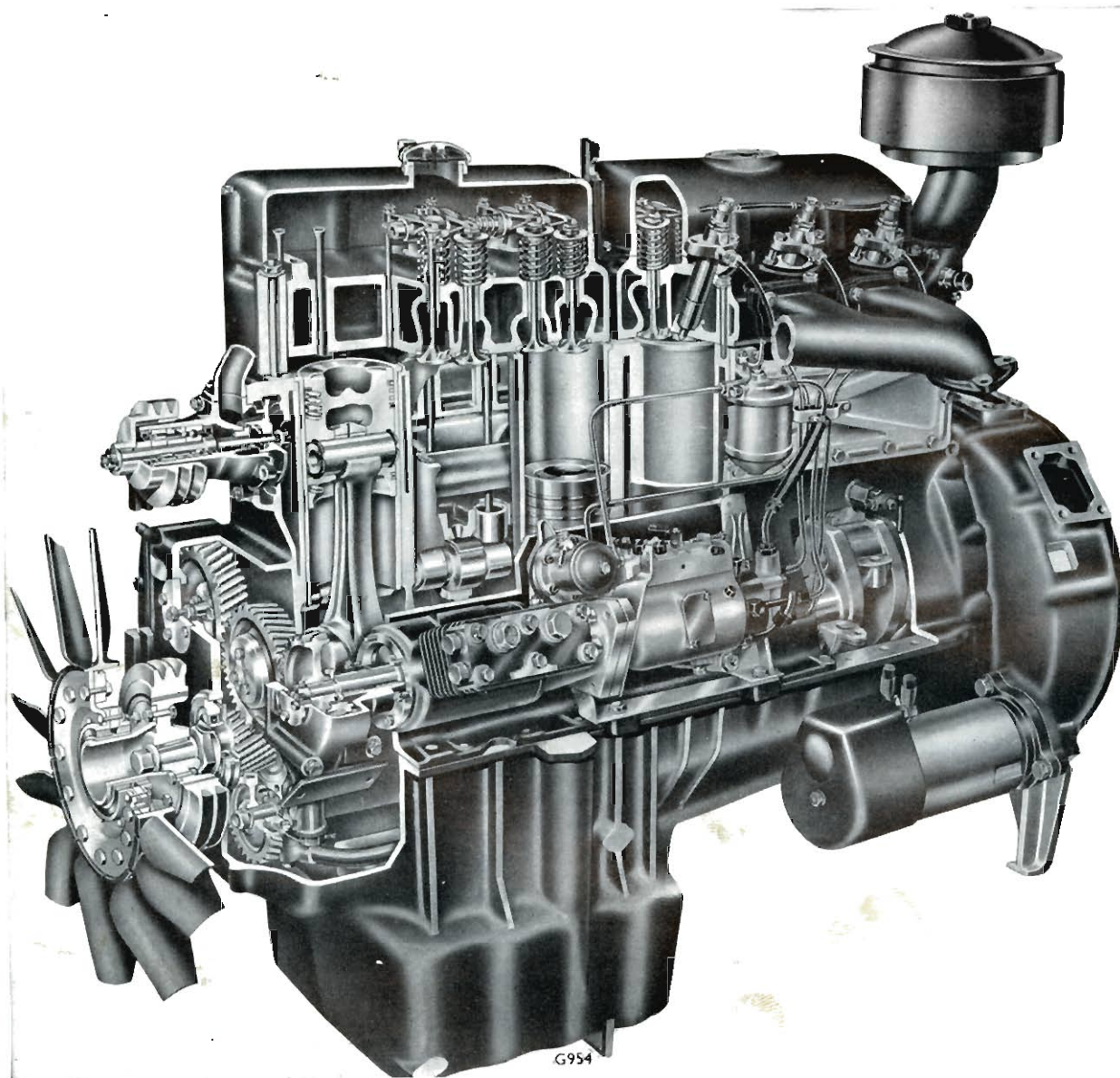


Fig. B1 Cut-away view of typical vertical engine

## INTRODUCTION

The A471 and A505 types, are new high efficiency, direct injection diesel engines, designed to provide sustained power, economical fuel consumption and the proven reliability of AEC products.

These engines can be converted, one to the other by a simple change of cylinder liners and piston assemblies.

Both vertical and horizontal versions are available, and are adaptable for automotive and industrial applications, the majority of parts being common to all types.

Maintenance is simplified by easily reached ancillaries, renewable dry cylinder liners, and thin shell type main and big-end bearings.

Incorporated in the twin cylinder heads, are the push rod operated valves, valve rocker gear and fuel injectors.

Wet sump lubrication system is maintained by a gear type oil pressure pump and, in addition on **certain engines**, a gear type circulating pump, these are mounted on the front main bearing cap.

A water pump assembly, mounted on the front of the engine casing, provides circulation for the cooling system, whilst on certain **horizontal type** engines the water pump is gear driven together with the shaft driven fan, dynamo or alternator from the Drive Box for Auxiliaries.

**The instructions in this Service Manual are applicable when the engine is removed from its mounting; when necessary, with minor differences, certain items may be serviced by adopting these instructions with the engine in situ.**

**All references to left-hand or right-hand mean as viewed from the flywheel end of the engine.**

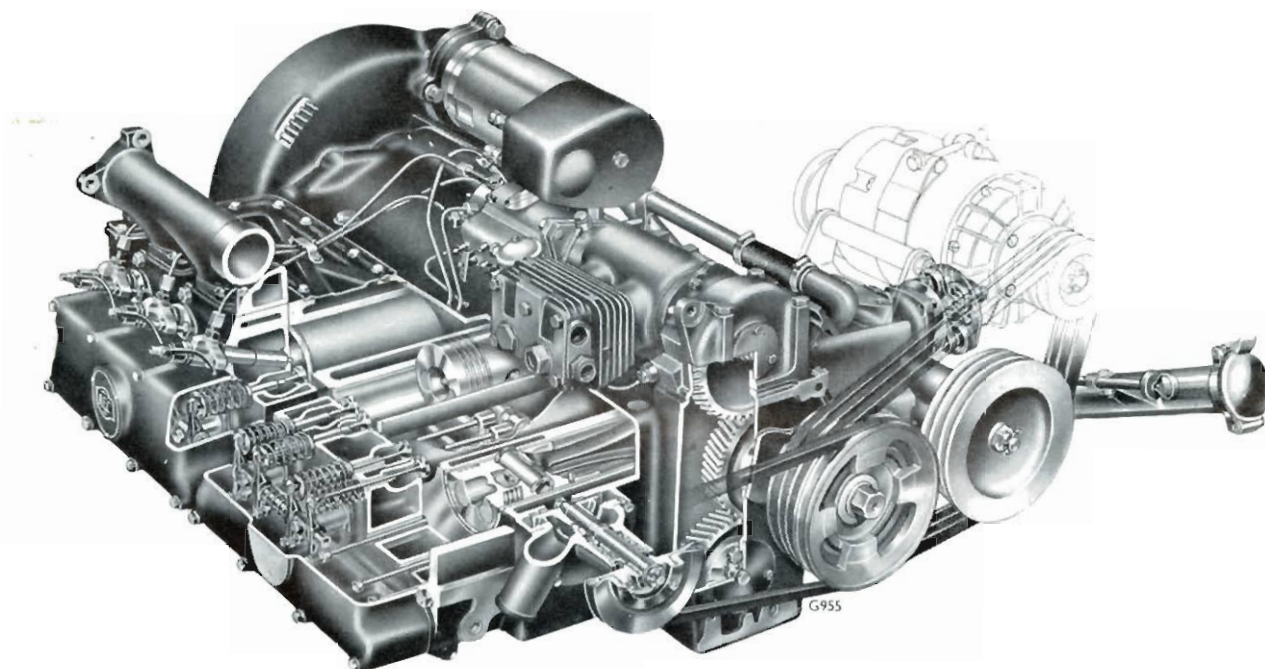
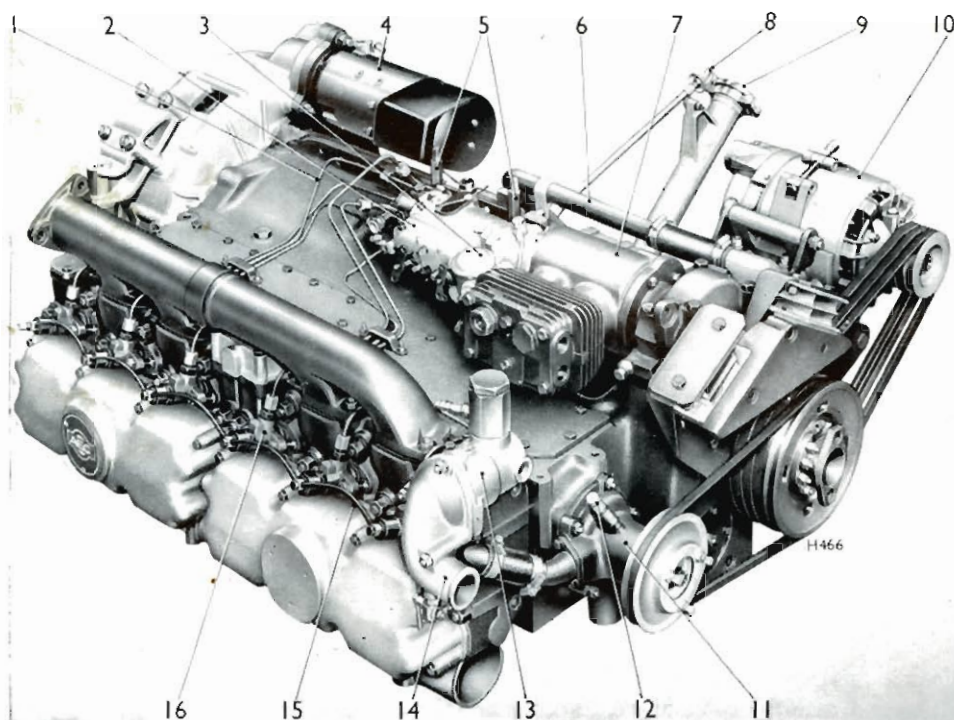


Fig. B2 Cut-away view of typical horizontal engine



**Key to Numbers:—**

1. FUEL DELIVERY PIPE
2. FUEL-INJECTION PUMP
3. FUEL-LIFT PUMP
4. STARTER MOTOR
5. SLEEVE NUTS—ENGINE LIFTING
6. BREATHER PIPE
7. AIR COMPRESSOR
8. DIPSTICK
9. OIL-FILLER CAP
10. ALTERNATOR
11. WATER PUMP
12. LUBRICATOR
13. THERMOSTAT BODY
14. WATER OUTLET PIPE
15. INJECTOR DRIBBLE GALLERY PIPE
16. FUEL INJECTOR

Fig. B3 View of typical horizontal engine

## Section 1

## ENGINE DATA

**Notes.**—The engine unit and equipment type numbers given in this section are abridged and do not cover minor differences. All communications concerning units or parts should quote the full and exact type number, with suffix, as stamped on the unit or part.

These engines incorporate Unified threads, each item of which can be identified by the accepted British Standard Institution markings.

## 471 ENGINE

Designation:—

AEC Type	..	..	..	..	AV471—Vertical—Chassis or Industrial engines.
Nominal Dimensions	..	..	..	..	112 mm. (4.41 in.) bore × 130 mm. (5.12 in.) stroke.
Cubic Capacity	..	..	..	..	469 cu. in. (7,685 cc.).
Maximum Torque	..	..	..	..	368 lb. ft. (50.9 Kg.M.) at 1,000 r.p.m. to 1,200 r.p.m.— Automotive engines. 350 lb. ft. (48.4 Kg.M.) at 1,000 r.p.m. to 1,200 r.p.m.— Industrial engines.
Fuel-injection Pump Timing	..	..	..	..	14° B.T.D.C.—“Distributor” type pump.
Injector Nozzle	..	..	..	..	C.A.V. BDLL150S—0.27 mm. dia. holes.

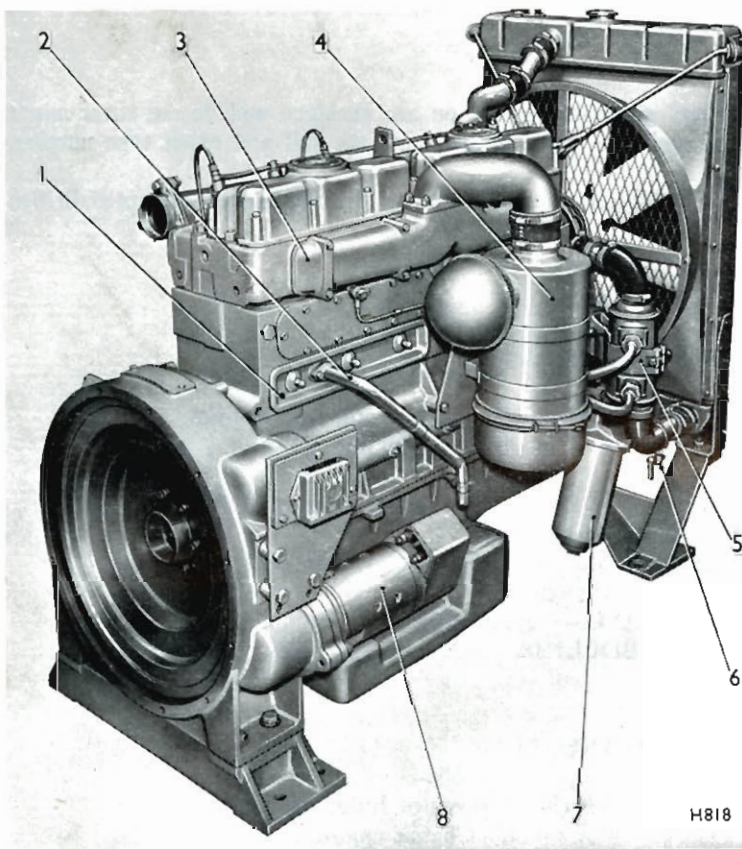
## 505 ENGINE

Designation:—

AEC Type	..	..	..	..	AV505—Vertical—Chassis or Industrial engines. AH505—Horizontal—Chassis engines.
Nominal Dimensions	..	..	..	..	116 mm. (4.56 in.) bore × 130 mm. (5.12 in.) stroke
Cubic Capacity	..	..	..	..	502 cu. in. (8,226 cc.).
Maximum Torque	..	..	..	..	391 lb. ft. (54.07 Kg.M.) at 1,200 r.p.m. to 1,400 r.p.m.— Automotive engines. 374 lb. ft. (51.7 Kg.M.) at 1,200 r.p.m. to 1,400 r.p.m.— Industrial engines.
Fuel-injection Pump Timing	..	..	..	..	15° B.T.D.C.—R.H. Engine } “Distributor” type pump. 12° B.T.D.C.—L.H. Engine } 26° B.T.D.C.—“In-line” type pump.
Injector Nozzle	..	..	..	..	C.A.V. BDLL140S—0.31 mm. dia. holes. Simms NL283—0.3 mm. dia. holes. NL473—0.31–0.33 mm. dia. holes.

## COMMON TO 471 AND 505 ENGINES

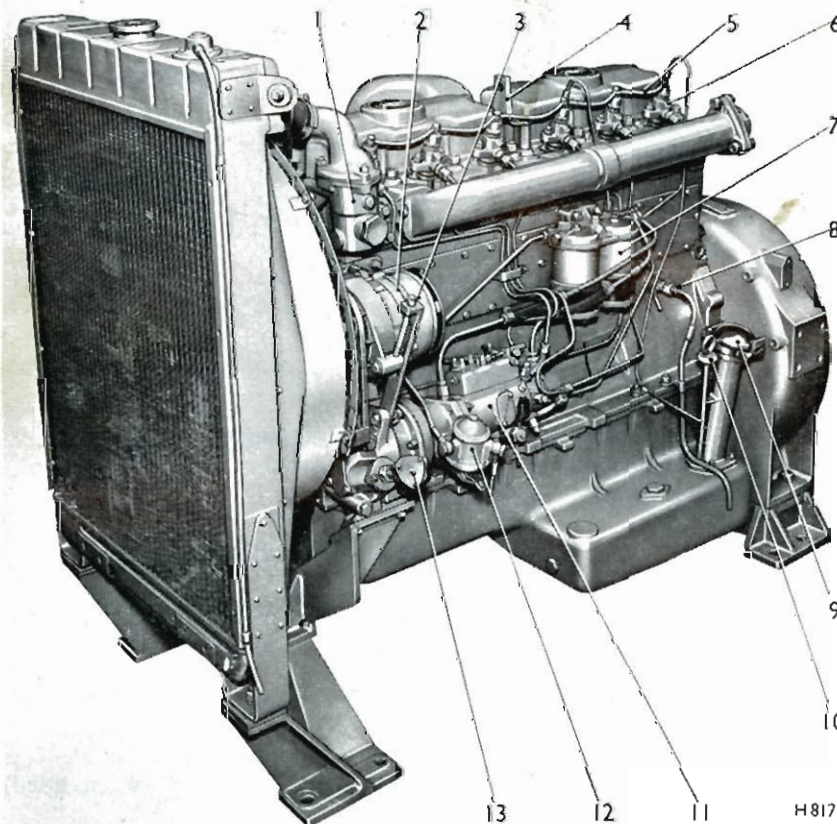
Approximate Weight (for lifting purposes)	..	..	..	..	1,365 lb. (619 Kg.)—Vertical—Chassis engine. 1,675 lb. (760 Kg.)—Vertical—Industrial engine. 1,485 lb. (674 Kg.)—Horizontal engine.
Number of Cylinders	..	..	..	..	6.
Firing Order	..	..	..	..	1, 5, 3, 6, 2, 4 (numbers taken from the fan drive end).
Compression Ratio	..	..	..	..	16 : 1.
Combustion Chamber	..	..	..	..	Direct injection. Toroidal cavity piston.
Timing Gear and Auxiliaries	..	..	..	..	Helical gear drive.
Valves	..	..	..	..	Overhead poppet, masked inlet.
Valve Tappet Clearance	..	..	..	..	0.010 in. to 0.012 in. (0.25 to 0.30 mm.) (Inlet and exhaust, engine HOT).
Water Pump	..	..	..	..	Centrifugal.
Lubrication System	..	..	..	..	Wet sump—gear type pressure and circulating (when fitted) pumps.



**Key to Numbers:—**

- 1. TAPPET INSPECTION COVER
- 2. BREATHER PIPE
- 3. AIR INLET MANIFOLD
- 4. AIR CLEANER
- 5. OIL COOLER
- 6. WATER DRAIN TAP
- 7. OIL FILTER
- 8. STARTER MOTOR

**Fig. B4** Right-hand side view of industrial engine



**Key to Numbers:—**

- 1. THERMOSTAT
- 2. ALTERNATOR
- 3. BELT ADJUSTMENT
- 4. ENGINE LIFTING EYE
- 5. INJECTOR DRIBBLE GALLERY PIPE
- 6. FUEL INJECTOR
- 7. FUEL FILTERS
- 8. CYLINDER WATER DRAIN PIPE
- 9. OIL FILLER CAP
- 10. DIPSTICK
- 11. FUEL-INJECTION PUMP
- 12. FUEL-LIFT PUMP
- 13. TACHOMETER DRIVE

**Fig. B5** Left-hand side view of industrial engine

Oil Capacity .. .. .	See Part A.
Oil Pressure .. .. .	See Section 19.
Injector Nozzle Holder .. .. .	C.A.V. NLA102S or Simms HB102S.
Injector Opening Pressure .. .. .	175 Atmospheres.
Fuel-lift Pump .. .. .	AC "U" or "VP" Series.
Fuel-injection Pump—"Distributor" type .. .. .	DPA.
—"In-line" type .. .. .	Minimec—SPGE6M.
Setting Code .. .. .	Refer to "Data" plate on Distributor fuel-injection pump body.
Maximum Runaway Speed (no load) .. .. .	
Maximum Runaway Speed (no load) .. .. .	2,200 r.p.m. or 2,400 r.p.m.—"In-line" type.
Governed Speed (under load) .. .. .	2,000 r.p.m., 2,200 r.p.m. or 2,400 r.p.m.
Idling Speed—"Distributor" type .. .. .	400 r.p.m.
—"In-line" type .. .. .	600 r.p.m.

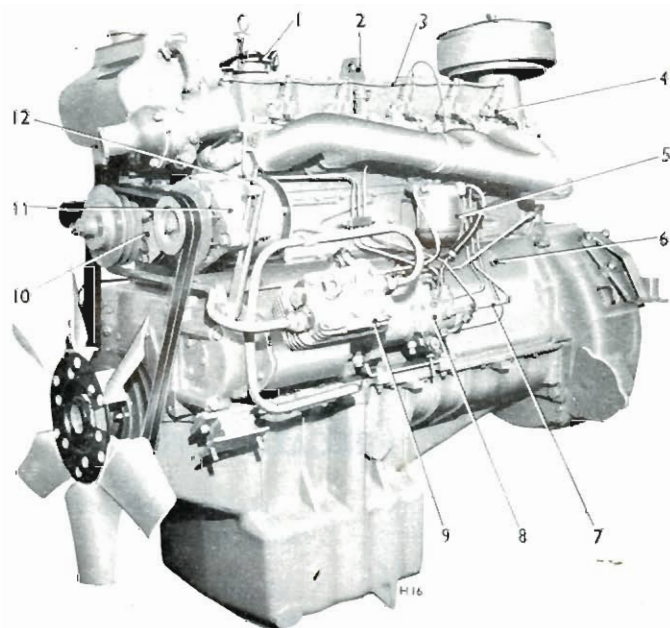
#### Notes.—

The fuel-injection pump is set and sealed to give the most suitable engine performance. Apart from adjustment of the idling stop (*see Section 26 or 27*), the pump setting **must not** be altered.

#### IF REQUIRED, ENGINE PERFORMANCE CURVES AND FUEL-INJECTION PUMP DELIVERY SETTINGS WILL BE SUPPLIED ON APPLICATION.

#### Engine Number

On the **vertical type** engine, the engine number is stamped on the engine casing, above the fuel-injection pump, whilst on the **horizontal type** engine the number is stamped on the engine casing adjacent to the fuel-injection pump. As these engines are manufactured in various forms, it is essential that in all communications the full and exact type number **with suffix**, is given.



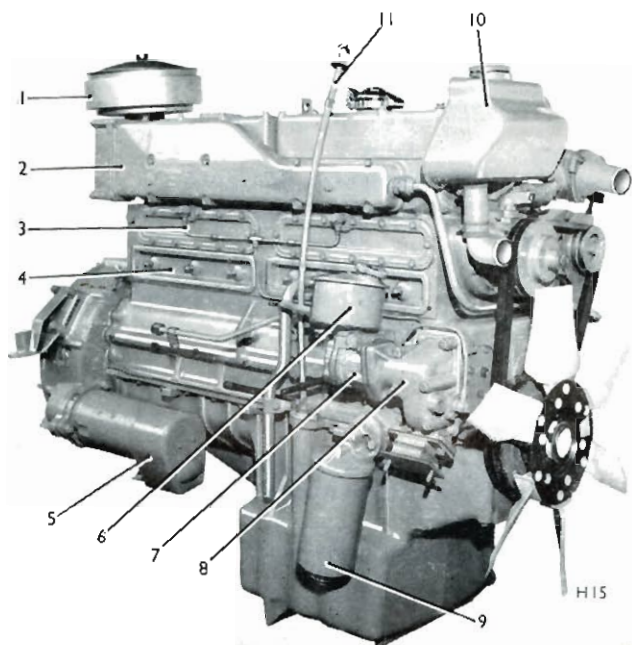
#### Key to Numbers:—

1. OIL FILLER CAP
2. ENGINE LIFTING EYE
3. INJECTOR DRIBBLE GALLERY PIPE

4. FUEL INJECTOR
5. FUEL FILTER
6. CYLINDER WATER DRAIN POINT
7. FUEL DELIVERY PIPE

8. FUEL-INJECTION PUMP
9. AIR COMPRESSOR
10. WATER PUMP
11. ALTERNATOR
12. BELT ADJUSTMENT

Fig. B6 Left-hand side view of typical vertical engine



**Key to Numbers:—**

1. AIR CLEANER
2. AIR INLET MANIFOLD
3. VALVE ROCKER OIL SUPPLY PIPE

4. TAPPET INSPECTION COVER
5. STARTER MOTOR
6. SUPPLY TANK
7. HYDRAULIC PUMP

8. DRIVE HOUSING
9. OIL FILTER
10. HEADER TANK
11. DIPSTICK

Fig. B7 Right-hand side view of typical vertical engine

## Section 2

## PERIODICAL ROUTINE MAINTENANCE

(see Part A)

## Section 3

## FROST PRECAUTIONS

If the engine cooling system is not filled with anti-freeze solution and the engine is to remain standing in the open with temperatures approaching freezing point, the cooling system must be completely drained.

### Vertical Type Engine

Drain cocks are fitted to the engine casing at the rear of the fuel-injection pump and at the bottom of the radiator, or, when fitted, on the water inlet pipe to the oil cooler.

### Horizontal Type Engine

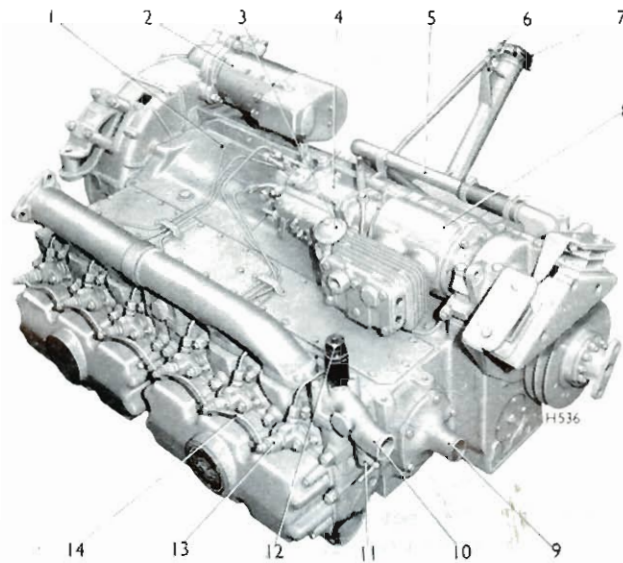
Drain cocks are fitted on the rear underside of the engine casing and on the radiator.

All these cocks must be opened to drain the system completely.

**Drain cocks should be tested immediately after opening by inserting a piece of wire to ensure that they are clear.**

Drain the engine when it is hot and do not leave it until the water has properly drained.

When drained place a notice in a conspicuous place stating that the cooling system is empty and the drain cocks are open.



#### Key to Numbers:—

1. FUEL DELIVERY PIPE
2. STARTER MOTOR
3. FUEL-LIFT PUMP
4. FUEL-INJECTION PUMP
5. BREATHER PIPE
6. DIPSTICK
7. OIL FILLER CAP
8. AIR COMPRESSOR
9. WATER INLET PIPE
10. WATER OUTLET PIPE
11. DRAIN COCK
12. WATER TEMPERATURE TRANSMITTER (when fitted)
13. FUEL INJECTOR
14. INJECTOR DRIBBLE GALLERY PIPE

Fig B8 View of typical horizontal engine, alternative to Figure B3

## Section 4

### CYLINDER HEADS

(See Figs. B9, B10, and B35)

The following instructions deal with the removal of the cylinder heads from the engine, but it is possible that adjacent parts may also have to be removed before these instructions can be carried out.

#### To Remove

Drain the engine cooling system (see Section 3) and disconnect or remove from the engine the following parts:—

When applicable disconnect the header tank steady bracket.

Valve covers and gaskets. (On the **horizontal** type engine, it is advisable to have a suitable container available before removal as a certain amount of oil will be in the covers).

Exhaust manifold.

#### Key to Numbers:—

1. ADJUSTING WASHER
2. BUSH
3. ROCKER ARM VALVE THIMBLE
5. SPLIT COLLET
6. COLLAR
7. INNER VALVE SPRING
8. OUTER VALVE SPRING
9. SLEEVE NUT
10. INJECTOR SLEEVE
11. ROCKER SHAFT
12. CYLINDER HEAD GASKET
13. VALVE SEATS
14. EXHAUST VALVE
15. INLET VALVE
16. CAMSHAFT
17. CAMSHAFT BUSH
18. GEAR WHEEL
19. THRUST BUTTON PLATE
20. SHIM
21. TAPPET
22. INLET VALVE GUIDE
23. CIRCLIP
24. PUSH ROD
25. VALVE RESTRAINER
26. EXHAUST VALVE GUIDE

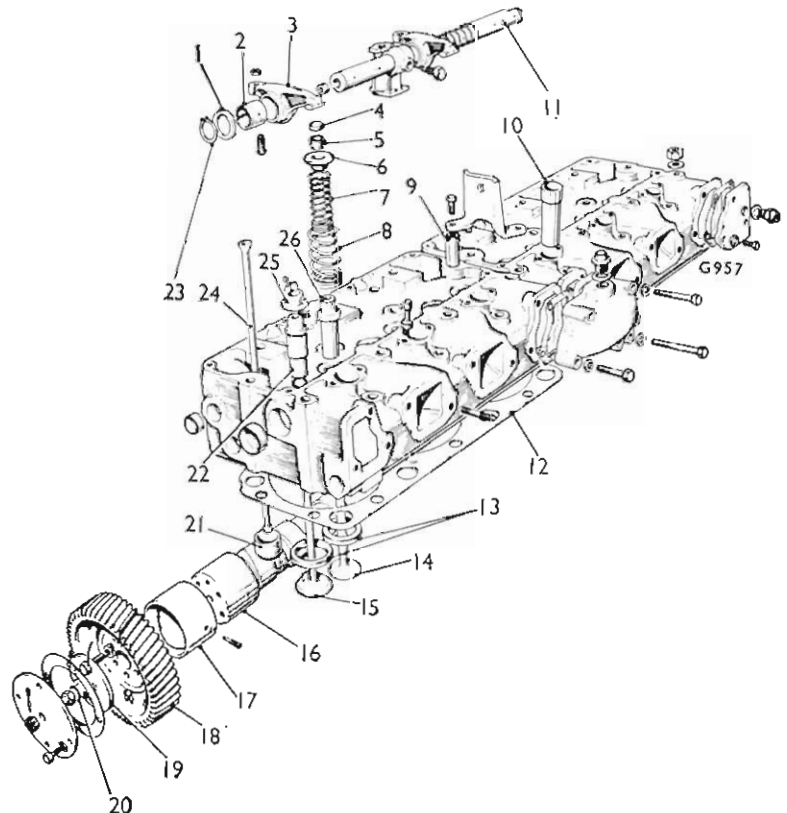


Fig. B9 Exploded view of cylinder head and valve gear assembly

Water connecting pipe between the two cylinder heads.

Air inlet manifold; first removing the air cleaner, or the flexible pipe and the compressor pipe from the opposing end.

Dipstick tube.

Valve rocker gear, valve thimbles and push rods.

Water temperature gauge connection.

Thermostat assembly (see Section 14).

Fuel delivery pipes.

Injector gallery pipe and injectors (see Section 29).

Remove and retain all the cylinder head special securing nuts and washers and lift off the cylinder heads.

Remove the cylinder head gaskets.

**IF A HEAD IS DIFFICULT TO REMOVE, TO AVOID DAMAGE, NEVER ATTEMPT TO LEVER IT OFF.**

### To Fit

Thoroughly clean the joint faces of the cylinder heads and the top face of the cylinders making certain that no foreign matter has entered the cylinder bores.

Check the gasket faces of the cylinder heads for distortion or pitting, if necessary, grind their faces flat before fitting, ensure to maintain the valve protrusion limit, quoted in Section 33 (A) (i).

Fit new cylinder head gaskets, making sure that the gaskets are placed in position correct side up as marked. **Do not** use jointing compound.

Ensure that the cylinder head securing studs are tight in the engine casing, lightly smearing the threaded portion of any replacement studs with the **special non-hardening** jointing compound **ONLY** obtainable from any AEC Service Depot or Agent, before screwing it into the engine casing. When fitting new studs, tighten to the specified torque loading quoted in Section 33.

Place the cylinder heads on the studs and locating dowels and refit all the cylinder head special nuts and hardened washers, ensuring that the special sleeve type nuts for the engine lifting block are fitted on their correct studs (see Fig. B9); tighten the heads down evenly by giving each nut a pull in the order shown in Figure B10. This operation should be repeated several times before reaching the specified

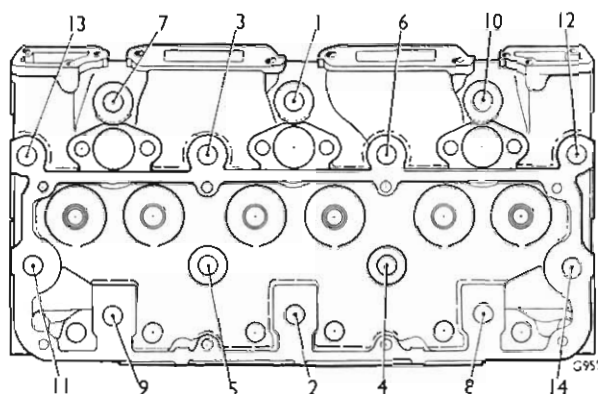


Fig. B10 Diagrammatic view of sequence for tightening cylinder head nuts

torque. (For torque spanner loadings see Section 33).

**Do not tighten cylinder head nuts beyond the specified torque.**

Fit the remaining parts in the reverse order to their removal.

Check the valve tappet adjustments (see Section 5). Using the specified torque, always re-tighten the cylinder head securing nuts after initial running, and whilst the engine is still **HOT** set the clearances between the valves and rockers (see Section 5).

Do not attempt to cure gasket leakage by excessive tightening of the nuts as this will only produce distortion of the cylinder head. It is much better to slacken off the nuts and re-tighten to the correct torque, or preferably fit a new gasket.

When assembling the air inlet manifold and valve covers, it is necessary to ensure that they are fitted in correct alignment to the cylinder heads to obtain a gas tight joint.

The correct assembly procedure is:—

### Vertical Type Engine

Fit the air inlet manifold first, but do not tighten the securing bolts until the valve covers have been fitted and their bolts fully tightened. Check for air gaps between the components.

### Horizontal Type Engines

Fit the valve covers first, but do not tighten the securing bolts until the air inlet manifold has been fitted and its bolts fully tightened. Check for air gaps between the components.

## Section 5

## VALVES

(See Figs. B9, B11 and B12)

### Springs—To Remove

Slacken off the tappet adjustment completely and, in the case of the four centre rockers on each head, slide the rocker along the shaft clear of the valve after slightly depressing the valve and springs to allow the adjusting screw to clear the push rod cup. **Bring the piston under the valve concerned to its top dead centre,**

then remove the thimble from the top of the valve, press down the collar with the tool listed in the Maintenance Equipment or alternatively, using the rocker shaft as a point of leverage in place of the tool adaptor shown in Figure B11, and remove the split collet.

Release the pressure from the tool and lift off the collar and remove the springs.

The procedure is similar for the end valves, but the rocker should first be removed by detaching the circlip from the end of the rocker shaft; the rocker can then be pulled off.

### Springs—To Fit

Check the tension of the valve springs.

When new, the lengths are:—

Inner, 58.1 mm. ( $2\frac{3}{8}$  in.) free. Load to compress to 35.2 mm. ( $1\frac{3}{8}$  in.) is 45.4 lb. (20.6 Kg.) Outer, 60.8 mm. ( $2\frac{3}{8}$  in.) free. Load to compress to 41.7 mm. ( $1\frac{3}{4}$  in.) is 82.2 lb. (37.3 Kg.).

Any spring which is outside these limits should be renewed.

Fit the springs (with the closed coil adjacent to the cylinder head), collar and collet; ensure that the collet fits tightly against the upper shoulder on the valve stem, then fit the thimble. Slide the rocker back into position and adjust the tappet clearance.

Check the clearances when the engine is **HOT** (see under "Valve Adjustment").

**Note.**—It is recommended that new circlips are fitted on the ends of the rocker shafts at engine overhaul periods.

### Valves—To Remove

Remove the cylinder heads in accordance with Section 4.

**Note.**—When using the tool shown in Figure B11 ensure that the tool adaptor is screwed down to the end of the thread on the injector stud.

Remove the valve springs as previously instructed in this section and withdraw the valve.

When removing the inlet valve, first lift the valve restrainer off its dowel and withdraw it by tilting slightly when at the top of the valve stem. The valve can then be removed from its guide.

### Valves—To Fit

Reverse the procedure given for removal.

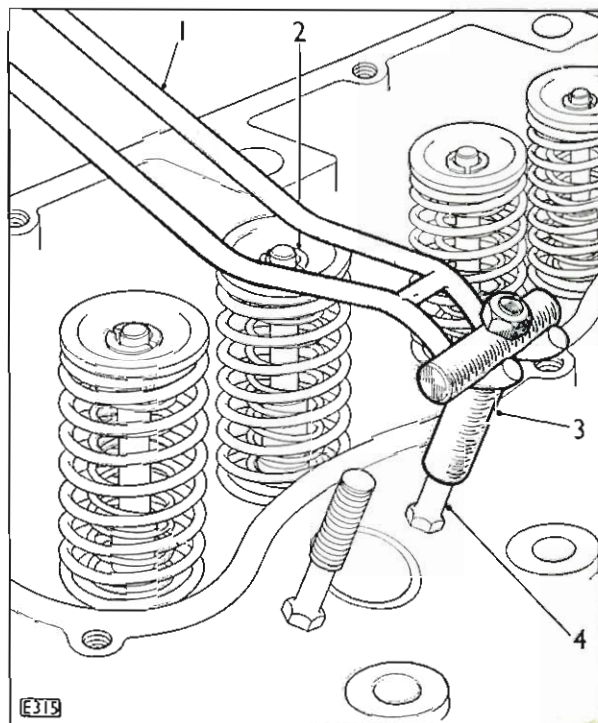
Before fitting the inlet valve, ensure that the "O" ring located in a groove in the lower end of the inlet valve guide is in good condition, renew if necessary.

**When refitting inlet valves**, be sure to fit restrainer after inserting the valve in its guide, tilting the restrainer slightly so that it will pass over the end of the valve stem, then locate the restrainer on its dowel.

### Valve Grinding

The valves of each cylinder head should be kept apart and when refitted should be in the same position. The valves are numbered on the head for guidance starting from the fan drive end of the engine. No numbers appear on the cylinder heads.

When grinding inlet valves, the valve restrainer must not be fitted otherwise the valve cannot be rotated; use a suction type tool as listed in the Maintenance Equipment.



#### Key to Numbers:—

1. TOOL FOR DEPRESSING VALVE SPRING
2. VALVE COLLAR—NOTE VALVE THIMBLES REMOVED
3. TOOL ADAPTOR
4. INJECTOR SECURING STUD

Fig. B11 Method of removing valve springs, with rocker shaft removed.

**Note.**—When cylinder head valve seats become worn the heads should be returned to any AEC Service Depot or Agent, for detachable type seatings to be fitted, or reconditioned heads obtained in exchange.

### Valve Adjustment

**Valve tappet clearances should always be checked after tightening cylinder head nuts with the engine HOT** (see Fig. B10).

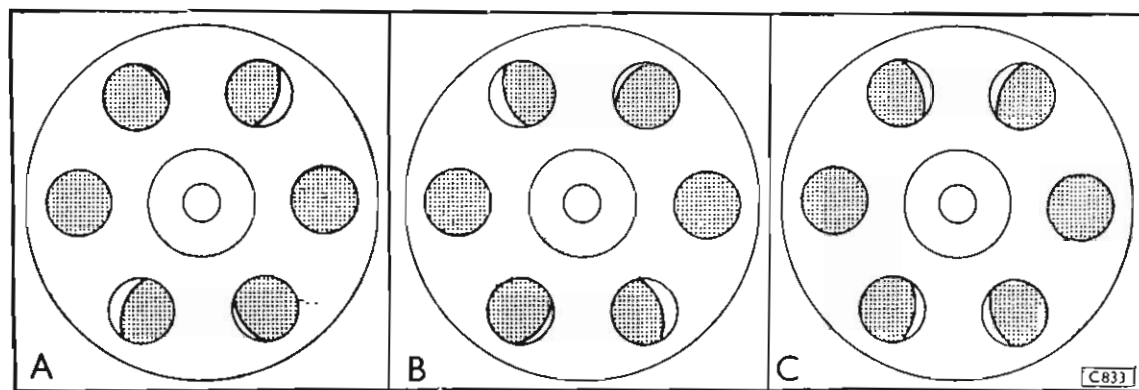
The running clearance between each valve thimble and rocker pad must be 0.010 in. to 0.012 in. (0.25 to 0.30 mm.) for both inlet and exhaust valves.

Clearances must be set when the engine is **HOT** and the tappets are on the backs of the cams.

To facilitate turning the crankshaft and to obviate the possibility of the engine starting inadvertently, slacken the injector securing nuts, thus releasing compression from the cylinders, also slacken the fuel delivery pipe union nuts from the fuel-injection pump.

Turn the crankshaft by applying a suitable tool to the flywheel, until the valve is open fully, then turn through one complete revolution to bring the tappet on to the back of the cam.

Treat each valve separately in this way.



#### Key to Letters:—

A. POSITION OF CAMSHAFT GEAR WHEEL WHEN CAMSHAFT CAN ONLY BE ADVANCED

B. POSITION OF CAMSHAFT GEAR WHEEL WHEN CAMSHAFT CAN ONLY BE RETARDED

C. POSITION OF CAMSHAFT GEAR WHEEL WHEN CAMSHAFT CAN BE EITHER ADVANCED OR RETARDED

Fig. B12 Alternative positions for camshaft timing

To adjust the tappet clearance, slacken the locknut, then turn the adjusting screw by means of a screw-driver in the slot provided.

When the correct clearance, is obtained, hold the adjusting screw in position with the screw-driver and at the same time tighten the locknut (*see Fig. B9*)

Tighten the fuel delivery pipe unions and injector securing nuts.

Alternatively, the tappet clearance may be adjusted whilst running the engine at idling speed.

**Note.**—To ensure free movement of the rocker arms, washers of varying thicknesses are available for fitting between the arm and the circlip at each end of the rocker shaft (*for dimensions of the washers available see Section 33*).

#### Valve Timing—To Check

The firing order is 1, 5, 3, 6, 2, 4 (numbers taken from the front of the engine).

The flywheel rim is marked to show Top Dead Centre No. 1 thus, "T.D.C. 1" for numbers 1 and 6 cylinders, and the part preceding this marking is graduated in degrees, the inlet valve opens at between 3° and 9° B.T.D.C.

**The movement of one hole on the vernier adjustment is equivalent to approximately 6° on the flywheel rim.**

The timing pointer is fitted in an aperture on the flywheel housing.

To obtain correct calculated valve timing, tappet clearance must be set to 0.021 in. (0.53 mm.) dead with the engine COLD.

After obtaining the correct valve timing, reset the tappet clearance to its original setting of 0.012 in. (300 μm.).

**To check the valve timing** turn the flywheel in a clockwise direction (viewed from the front of the engine) and rotate the inlet push rod or valve spring and collar on No. 6 cylinder. As soon as the push rod or spring is too tight to rotate freely the inlet valve will be at opening point.

The timing pointer on the flywheel housing should then point to the appropriate mark on the flywheel quoted in the preceding paragraphs.

A slight effort will be required to turn the push rod or spring of No. 6 cylinder if the timing is correct.

**To alter the valve timing** remove the fan and water pump drive belts (*see Section 15*), when fitted.

Remove the thrust plate cover which will expose the thrust button plate and securing setscrews.

Remove the locking wire and setscrews and detach the thrust button plate, ensuring that the camshaft gear wheel does not rotate.

The necessary vernier adjustment can then be made providing the camshaft gear wheel is in such a position whereby the camshaft can be advanced or retarded (*see Fig. B12C*).

If it is only possible to advance the camshaft on the vernier adjustment (*see Fig. B12A*) and a retarded movement is required, the camshaft gear wheel must be removed and fitted in a position which will allow the camshaft to be retarded.

The preceding paragraph will also apply if it is only possible to retard the camshaft when an advancement is required (*see Fig. B12B*).

When the valve timing is correct assemble the parts in the reverse order to their removal.

Check the tappet clearances after the engine has been run and is **HOT** (*see under "Valve Adjustment"*).

## Section 6

## SUMP AND OIL STRAINER

(See Figs. B7 and B13)

The following instructions deal with the removal of the sump from the **vertical type** engine, but it is possible that adjacent parts may also have to be removed before these instructions can be carried out.

**To Remove**

Drain the oil by removing the drain plug from the sump, and remove the following parts:—

Dipstick and dipstick tube.

Inlet and outlet supply pipes to oil cooler (when fitted).

Breather pipe clip.

Oil filter (see Section 22).

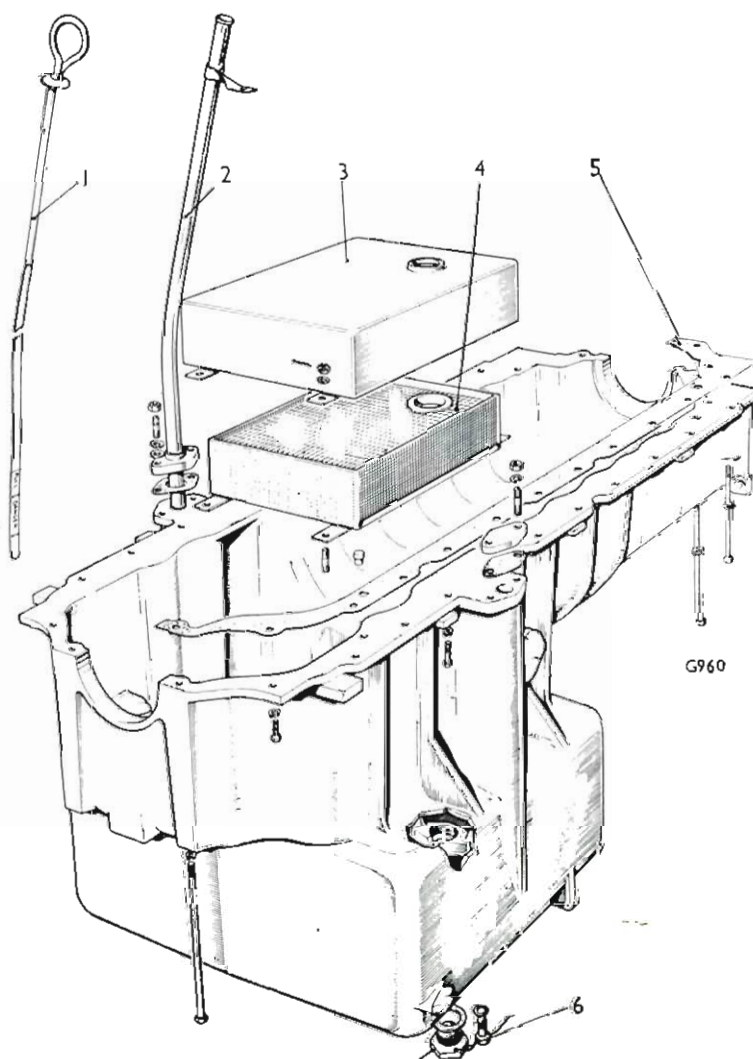
Starter motor (see Section 18).

All setscrews securing the sump to the engine casing and flywheel bell housing.

When lifting off the sump care should be taken to ensure that the oil suction pipe is not damaged and the spring, felt washer and "O" ring fitted on the suction pipe are retained (see Fig. B31).

**Oil Strainer**

Before the sump is refitted the oil strainer must be removed and cleaned as follows:—

**Key to Numbers:—**

- 1. DIPSTICK
- 2. DIPSTICK TUBE
- 3. OIL STRAINER COVER

- 4. OIL STRAINER
- 5. JOINT
- 6. DRAIN PLUG

Fig. B13 Exploded view of sump assembly

Detach the oil strainer and cover by removing the split pins and nuts securing them to the sump.

Wash the strainer and cover thoroughly in clean paraffin and allow them to drain.

#### To Fit

Fit the oil strainer and cover to the sump, ensuring that the holes for the oil suction pipe in the strainer and cover are in line.

If the bottom half of the crankshaft rear wearing sleeve has been removed, care should be taken to ensure that it is fitted in its original position, the butting faces of the top and bottom halves of the

sleeve should be offset, approximately  $45^\circ$ , from the centre line of the engine casing (see Fig. B21).

Fit a joint 0.008 in. (0.20 mm.) thick, with non-hardening jointing compound, between the engine casing and the sump.

Ensure that the spring, felt washer and "O" ring are fitted on the oil suction pipe, align the locating dowel and fit the sump, securely tightening the set-screws.

Fit the remainder of the parts removed in the reverse order to their removal.

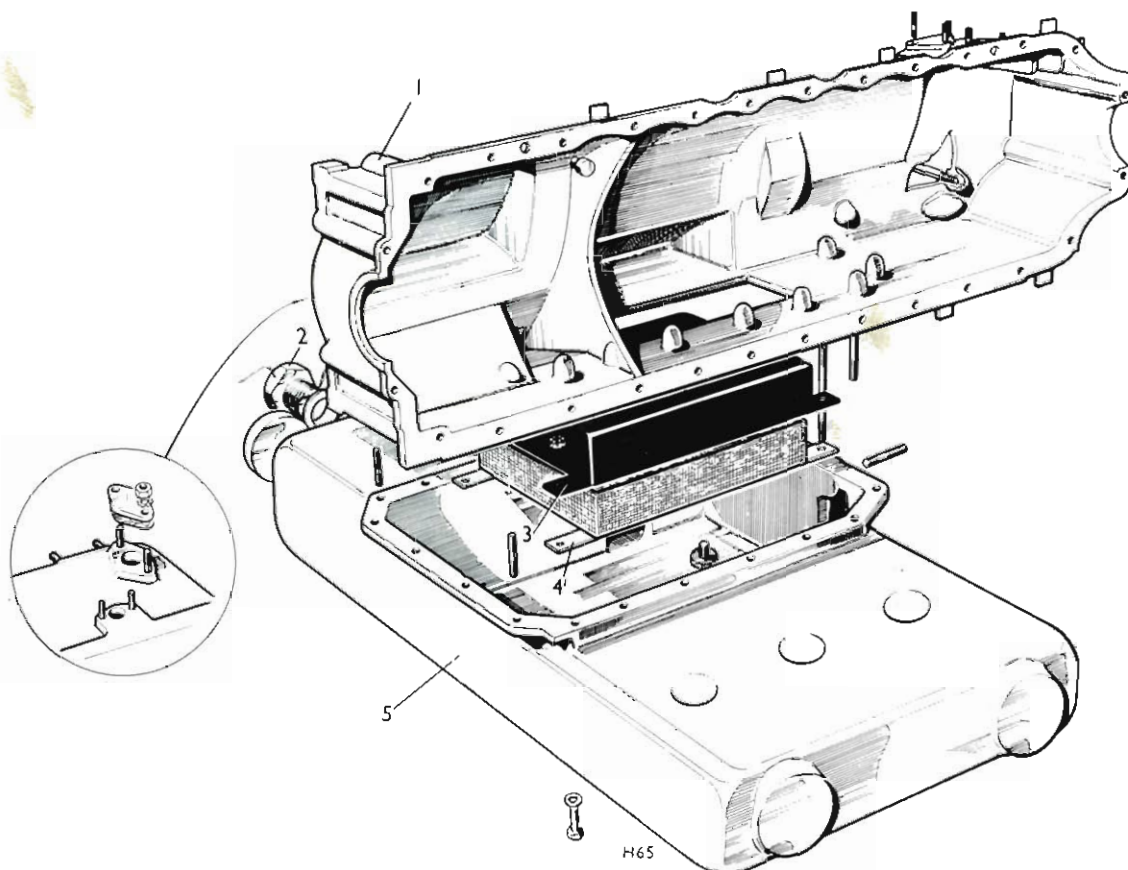
Fill the sump with fresh oil (see Part A) and finally check the oil pressure (see Section 19).

## Section 7

### ENGINE CASING EXTENSION

(See Figs. B3 and B14)

The following instructions deal with the removal of the engine casing extension from the **horizontal type** engine, but it is possible that adjacent parts may also have to be removed before these instructions can be carried out.



**Key to Numbers:—**  
1. EXTENSION CASING

2. DRAIN PLUG  
3. COVER

4. OIL STRAINER  
5. SUMP

Fig. B14 Exploded view of engine casing extension and sump assembly

**To Remove**

Drain the oil by removing the drain plug from the sump, and remove the following parts:—

Oil sump, retaining the spring, felt washer and "O" ring fitted on the oil suction pipe.

Dipstick and filler tubes.

Breather pipe.

Oil filter (*see Section 22*).

Alternator or dynamo complete with support bracket (*see Section 15*).

Disconnect the fuel delivery pipes, at their junction, located on the fuel filter support bracket, remove the bracket and filter.

All setscrews securing the engine casing extension to the engine casing, and flywheel bell housing.

When lifting off the engine casing extension care should be taken to ensure that the oil suction pipe is not damaged.

**To Fit**

Before the engine casing extension and oil sump are refitted, the oil strainer must be detached and cleaned as instructed in Section 6.

If the bottom half of the crankshaft rear wearing sleeve has been removed, care should be taken to ensure that it is fitted in its original position, the butting faces of the top and bottom halves of the sleeve should be offset, approximately 45°, from the centre line of the engine casing (*see Fig. B21*).

Fit a joint 0.008 in. (0.20 mm.) thick, with non-hardening jointing compound, between the engine and extension casings.

Fit the engine casing extension, making certain that the dowels fit into their respective holes, refit the setscrews, nuts and washers and tighten.

Refit the remainder of the parts removed in the reverse order to their removal.

Fill the sump with fresh oil (*see Part A*) and finally check the oil pressure (*see Section 19*).

**Section 8****CONNECTING RODS AND PISTONS**

(*See Figs. B15, B16 and B21*)

**To Remove**

Drain the oil from the engine and remove the sump (*see Section 6*), or alternatively, on the **horizontal type** engine, the engine casing extension (*see Section 7*).

Remove the cylinder heads and gaskets (*see Section 4*) and any carbon deposit from the top of the cylinder bores.

Disconnect the oil suction pipe from the oil pressure pump.

Before dismantling the big-end bearings, and to ensure correct assembly, carefully examine parts and ascertain how everything is numbered, and in what position the big-end nuts are pinned (*see Figs. B15 and B16*).

Remove the big-end nuts with a box key, remove the caps and place them in sequence on a clean bench.

Push the connecting rods carefully into the cylinder bores until the pistons can be removed from the top; care must be taken to ensure that the connecting rods do not score the bore when being withdrawn and the connecting rod bolts do not mark the crank pins.

It is advisable to cover the connecting rod bolts with protective tubes before removal.

**Notes.—**

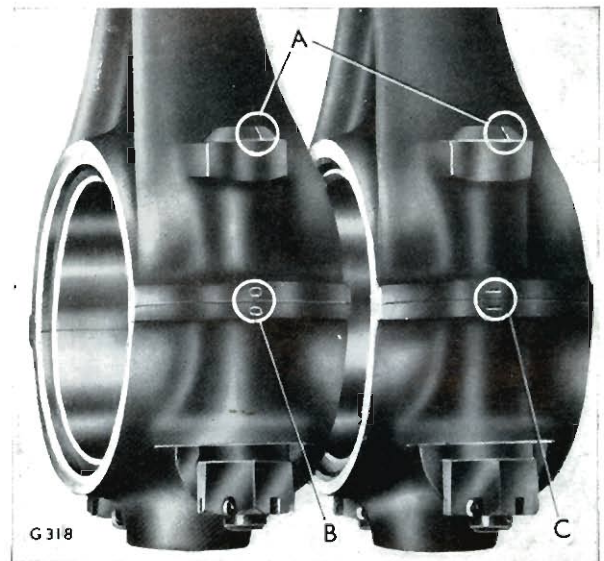
(i) The pistons cannot be removed through the crankcase.

(ii) On no account should the connecting rods be marked either with a file or a centre punch to denote the cylinder or unit number, as they are already

marked and any further markings of any kind are prone to set up local stress concentrations which may result in failure of the rod.

**To Separate Piston from Connecting Rod**

Remove the gudgeon pin circlips, using the special pliers listed in the Maintenance Equipment.

**Key to Letters:—**

A. BOLT ALIGNMENT MARK

B. REVERSE OR INJECTOR SIDE  
C. OBVERSE SIDE

**Fig. B15** Connecting rod big-end showing markings on rod and cap

Heat the piston in hot water and press out the gudgeon pin by thumb pressure; **do not** force the pin in or out of the piston when cold.

Check the piston rings; rings which show blackened or discoloured patches either on the working surfaces or the sides, should be renewed.

#### To Fit

Reverse the procedure of removal noting the following points:—

**Note.**—On late type horizontal engines, a low friction piston and rings has been introduced, consisting of two compression rings and one special spring loaded conformable type scraper ring; care should be exercised when handling these rings, no bottom scraper ring is fitted.

**Important.**—To ensure correct assembly, the marking "Injector Side" is stamped on the crown of the piston, and when fitting should be mated with the letter "O" stamped on the connecting rod and cap.

Heat the piston in hot water and press in the gudgeon pin by thumb pressure. **On no account must the piston be reamed out.**

It is recommended that **new circlips** are used when fitting the piston.

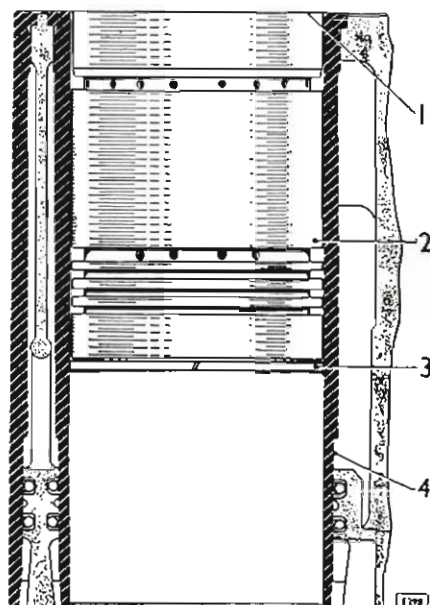
Clean all carbon from the piston rings and their grooves, then check with feelers for excessive side clearance between each piston and its rings.

To measure the piston ring gap, place the piston ring in its correct cylinder bore so that it is approximately half way down, square it up by means of a piston inserted into the bore from the top of the engine casing, until the piston skirt is flush with the "top" face of the engine casing (see Fig. B17).

For the above clearances when new see Section 33.

Pistons, connecting rods, caps, big-end bolts and the nuts are numbered in sequence from the front end, and **must be fitted to the cylinders from which they were removed.**

The reverse side of each rod and cap are marked with the letter "O" and on erection all the "O's" must be on the injector side of the engine. **Under**



#### Key to Numbers:—

1. PISTON SKIRT FLUSH WITH FACE OF CYLINDER BLOCK
2. PISTON
3. PISTON RING
4. CYLINDER LINER (Type shown, not applicable)

Fig. B17 Method of measuring piston ring gap

**no circumstances must the numbers 1,2,3, etc., appear mated to the letter "O" (see Fig. B15).**

When new bearings are necessary, it is important that these should provide the clearance specified in the charts in Section 33.

When installing new bearings, the crank pins must be examined for signs of scoring, and measured with a micrometer, checking at the same time for the amount of ovality.

If necessary, the crank pins should be reground to one of the standard sizes listed in Section 33. Replacement bearings are available in plan and under-sizes, details of which appear in the charts in Section 33.

Remove and install one set of bearings at a time. Crank pins should be free from scores and the clamping surfaces of caps and rods should not be damaged or filed. **No attempt should be made to "let up" a cap by filing either the rod or cap.**

At complete overhaul periods always fit new connecting rod bolts and nuts with their special design of split pin, ensure that the location mark on the heads of the bolts are fitted in the outer dead centre position as shown in Figure B15.

**Important.**—Replacement rods are not marked to indicate their cylinder number. They should, therefore, be stamped with a punch in a similar manner to the rod to be displaced. **Do not mark or file the rods in any other way.**



#### Key to Numbers:—

1. CONNECTING ROD CAP
2. NUT (NOTE CORRECT POSITION FOR NUMBERS WHEN ASSEMBLING)
3. CONNECTING ROD BOLT
4. SPECIAL TYPE SPLIT PIN

Fig. B16 Connecting rod big-end, showing markings on nuts and bolts

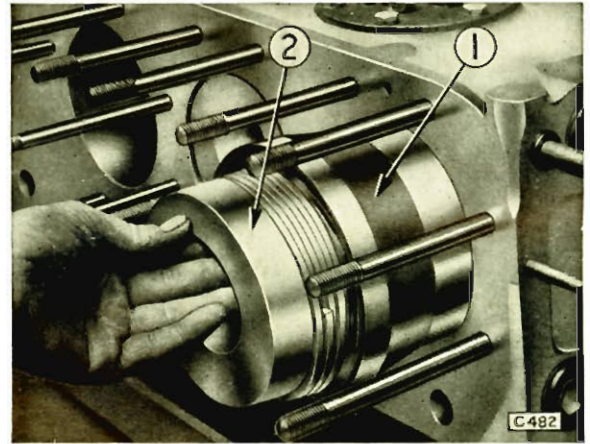
Before fitting any connecting rod see that your hands are clean, then wipe the crank pin with clean muslin, and lightly smear with clean engine oil both on the crank pin and the surface of the bearing shell; clean and install one set at a time.

**Cleanliness in handling bearings is vital to successful running.**

In order that the rings may be entered into the bore without difficulty, the guide tool, illustrated in Figure B18 and listed in the Maintenance Equipment, should be used.

The piston and rings should be smeared with clean engine oil, the rings spaced so that the gaps are staggered, and the guide tool fitted on the piston before pushing the piston and connecting rod into the cylinder bore.

Connecting rod nuts should be tightened with a suitable torque spanner. Tighten until the two centre "pop" marks on the nut appear on either side of the split pin hole. (*For torque spanner loadings see Section 33*).



**Key to Numbers:—**

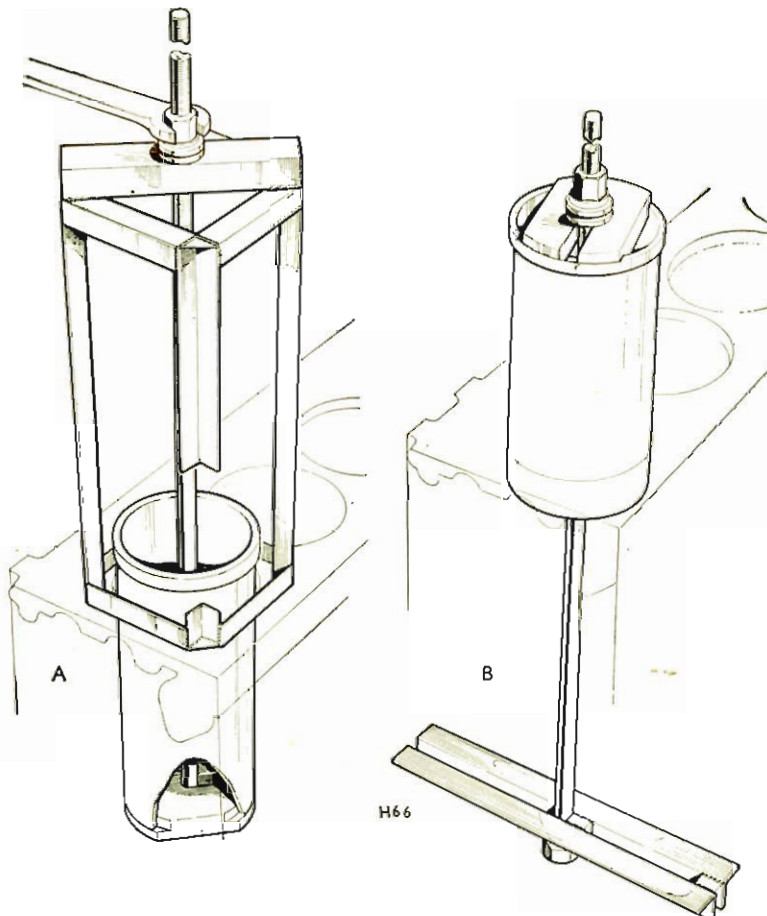
1. PISTON FITTING TOOL      2. PISTON

**Fig. B18** Method of fitting pistons

## Section 9

## CYLINDER LINERS

(See Fig. B20)



**Key to Letters:—**

A. WITHDRAWING LINER      B. INSERTING LINER

**Fig. B19** Typical tool and method of removing cylinder liner

**Note.**—Only if facilities are available, should the following instructions be carried out; in the event of difficulties operators should contact any AEC Service Depot or Agent for fuller details of tools and instructions.

#### To Remove

Remove the cylinder heads (*see Section 4*).

Remove the sump or extension casing (*see Section 6 or 7*).

Remove the pistons and connecting rods (*see Section 8*).

Insert the tool, as shown in Figure B19 and listed in the Maintenance Equipment, into the cylinder bore and withdraw the liner; it may be found necessary to use mechanical assistance to withdraw the liner.

#### To Fit

Thoroughly clean cylinder bore to remove any carbon deposit that may have formed.

Insert the new liner into the engine casing and draw it home with the tool as shown in Figure B19; when correctly seated the top face of the liner flange must

be 0.002 in. (0.05 mm.) BELOW the surface face of the engine casing.

Finally, hone the liner to the bore diameter (*see Section 33*); it is **most important** that the honing limits are strictly adhered to.

Hone with 120 grit carborundum stones to within finish tolerance dimensions, to give a surface finish of 30-40 micro ins. "centre line average".

Finish hone with 320 grit carborundum stones, removing minimum stock to give a final surface finish of 12-20 micro ins. "centre line average".

The hone should be operated at 36 strokes per minute reciprocating at a speed of 155 r.p.m., using "Delopena No. 4" or a similar fluid as a coolant.

Fit the remaining parts in the reverse order to removal.

**Note.**—Should it be necessary to re-surface the monobloc facing, refer to Section 33 (D) (i), for flashing limits and corresponding cylinder head gaskets.

#### Key to Numbers:—

1. BREATHER PIPE
2. TAPPET COVER
3. WATER JACKET COVER
4. CYLINDER LINER
5. REAR CUP PLUG
6. WATER DRAIN COCK
7. WATER JACKET COVER
8. MAIN BEARINGS
9. CRANKSHAFT THRUST STRIPS
10. FRONT MAIN BEARING CAP and OIL PUMP BODY
11. TIMING GEAR IDLER WHEEL
12. FLANGE
13. HUB
14. MOUNTING FOR CHANGE-SPEED BOX
15. CAMSHAFT FRONT BEARING
16. COMBINED COVER and ENGINE SUPPORT BRACKET
17. PUSH ROD GUIDE PLATE

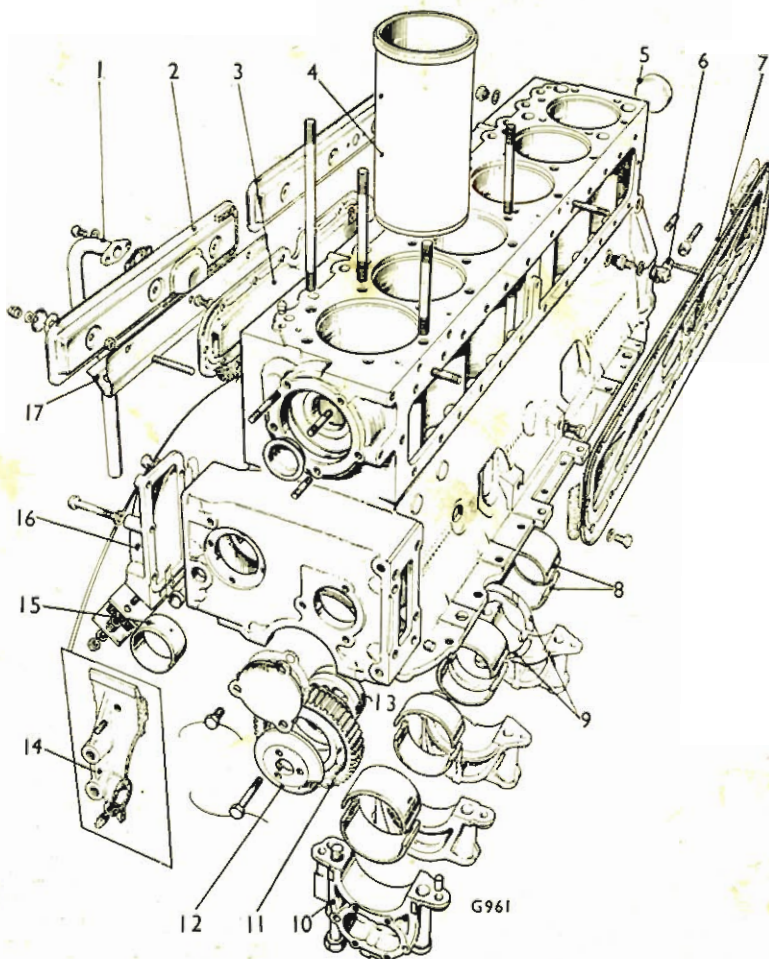
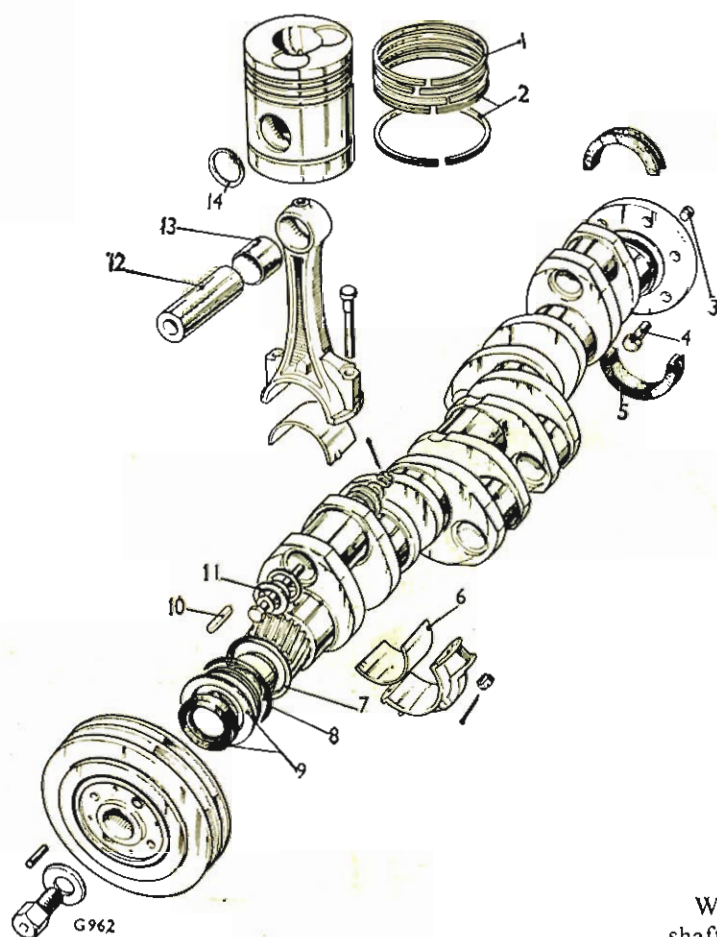


Fig. B20 Exploded view of engine casing assembly

## Section 10

## CRANKSHAFT

(See Figs. B20 and B21)



## Key to Numbers:—

1. COMPRESSION RINGS
2. SCRAPER RINGS
3. FLYWHEEL LOCATING DOWEL
4. FLYWHEEL SECURING BOLT
5. REAR WEARING SLEEVE
6. BIG-END BEARING
7. OIL THROWER DISC
8. 'O' RING
9. OIL SEAL and HOUSING
10. COUPLING KEY
11. CRANK PIN END CAP
12. GUDGEON PIN
13. SMALL-END BUSH
14. CIRCLIP

Fig. B21 Exploded view of crankshaft assembly

## To Remove

Remove the engine from the vehicle (see Part A) or bed-plate.

Remove the fluid flywheel or clutch assembly (when fitted) (see Part C.).

Detach the flywheel by removing the securing nuts, and placing two  $\frac{3}{8}$  in. U.N.F. or B.S.F. setscrews, in the flywheel withdrawal holes. When these setscrews have been tightened evenly the flywheel can be lifted away from the crankshaft leaving the bolts and dowel in the crankshaft flange. **These bolts are a drive fit and should not be removed** (see Fig. B21).

Remove the sump (see Section 6), or the engine casing extension (see Section 7).

Remove the oil circulating pump suction and delivery pipes (when fitted).

Remove the cylinder heads (see Section 4).

Remove the pistons and connecting rods (see Section 8).

Remove the drive belts (when fitted) (see Section 15).

When applicable, remove the fan from the crankshaft pulley.

Remove the combined crankshaft pulley and damper, or alternatively, the drive coupling using the tool listed in the Maintenance Equipment.

Remove the setscrews securing the main bearing caps.

Remove the oil circulating pump (when fitted) and the front main bearing cap which contains the oil pressure pump and the remaining main bearing caps, taking care of the thrust strips fitted to No. 4 cap (see Fig B20).

Lift out the crankshaft complete with the oil seal and driving gear (see Fig. B21).

The crankshaft has hollow crank pins and drilled journals, which form passages for the oil from the pressure pump. When the engine is overhauled the crank pin end caps must be removed and the sludge cleaned out (see Fig. B22).

The main bearing shells are located by mating the tag on the shell with the slots in the engine casing and cap. The position of the tag ensures that the shells are fitted correctly.

**Key to Numbers:—**

1. CRANK PIN  
2. MAIN JOURNAL  
3. GROOVES FOR OIL SEAL

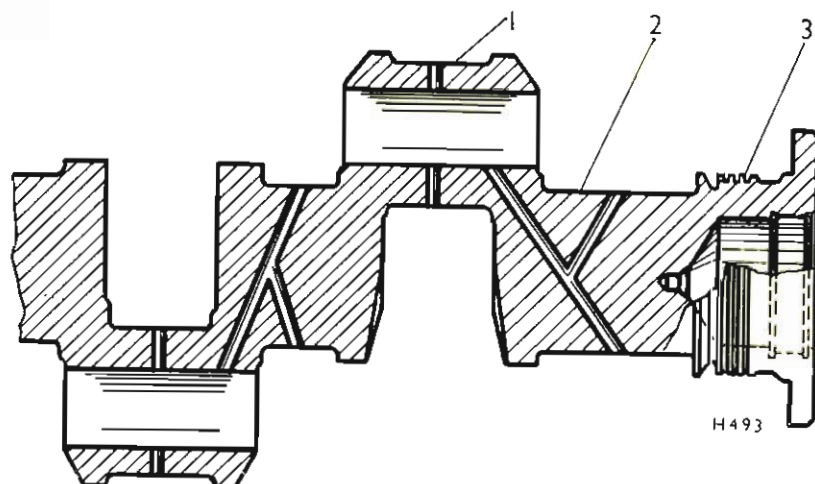


Fig. B22 Diagram of crankshaft oil passages

**To Fit**

If the crankshaft driving gear has been removed, assemble the front end of the crankshaft as follows (see Fig. B21):—

Fit the key, followed by the driving gear, oil thrower disc, wearing sleeve, oil seal and housing, in that order. Ensure that the lip of the oil seal points towards the crank webs and also that the oil seal housing "O" ring is in good condition and renew if necessary; the complete assembly is finally secured when the crankshaft pulley or coupling is fitted.

Before fitting the crankshaft, prime the hollow crank pins with clean engine oil and see that the copper washers are fitted beneath the bolt heads and nuts securing the end caps and that each bolt is split-pinned. **These caps must be perfectly oil tight.**

Ensure that all parts are perfectly clean, lubricate the top half of the main bearings in the engine casing with clean engine oil, then fit the crankshaft. If the thrust strips have been removed from the engine casing they should be fitted with the "slotted" faces towards the crankshaft webs as shown in Figure B20.

Fit the thrust strips to No. 4 main bearing cap and fit the cap to the engine casing. Fit the remaining main bearings caps including the cap for No. 1, which incorporates the oil pump, lubricate the bearings in

the cap before fitting. The main bearing caps are numbered 1 to 7 from the front end and must be refitted to their original positions.

Securely tighten the main bearing cap setscrews to their correct torque loading, as given in Section 32.

Ensure that both halves of the rear wearing sleeve are fitted in their original position (see Fig. 21) and Sections 6 and 7.

Fit the remaining parts in the reverse order to their removal.

When mounting the flywheel, ensure that the dowel hole engages with the dowel on the crankshaft flange and that the securing nuts are tightened to the torque loading given in Section 33.

Adjust the water pump and dynamo or alternator drive belts (when fitted) (see Section 15).

Time the camshaft in accordance with Section 11 and the fuel-injection pump in accordance with Section 26 or 27, and check the oil pressure (see Section 19).

**Note.**—On certain engines, the fan is fitted with detachable blades, and if damaged can be renewed; ensure that the new blade is fitted in the same position as the one removed (see Fig. B23), and finally secured by the locking plate.

**Section 11****CAMSHAFT**

(See Figs. B9 and B20)

The following instructions deal with the removal of the camshaft from the engine, but it is possible that adjacent parts may also have to be removed before these instructions can be carried out.

**To Remove**

Remove the drive belts (when fitted) (see Section 15).

Remove the sump (see Section 6) or the engine casing extension (see Section 7).

Remove the valve rockers and push rods (see Section 4).

Remove the breather pipe and dipstick tube.

Remove the tappet inspection cover and withdraw the tappets.

When applicable, remove the fan from the crankshaft pulley.

Unscrew the securing setscrews and remove the

camshaft gear wheel combined cover and engine front support bracket; or alternatively, on certain engines, the drive housing complete with the air compressor or power steering pump, whichever unit is fitted; this will expose the cheese-headed dowel securing No. 1 camshaft bearing.

Remove the camshaft thrust plate cover, detach the thrust button plate, push the camshaft back and take out the camshaft gear wheel through the inspection aperture.

Unscrew the camshaft No.1 bearing dowel which will allow the bearing to be removed with the camshaft; withdraw the shaft, the intermediate and rear bearings will remain in the casing.

### To Fit and Time

Fit the camshaft and front bearing into the engine casing, ensuring that the bearing hole is aligned with the hole in the engine casing before fitting the dowel.

Insert the camshaft gear wheel into the inspection aperture and secure it to the camshaft with the thrust button plate.

Adopt the following procedure to time the camshaft:—

The camshaft must be set so that the inlet valve commences to open between  $3^{\circ}$  and  $9^{\circ}$  B.T.D.C.

Movement of the vernier type adjustment as shown in Figure B12, ensures that the correct timing is obtained.

Fit the tappets and push rods to No. 6 cylinder and rotate the flywheel in a clockwise direction (viewed from the front of the engine) to the T.D.C. mark on the flywheel, so that the push rods are balancing on the cams, with the inlet push rod slightly below the exhaust push rod.

Fit the valve rocker assembly and rotate the flywheel one complete revolution, then adjust the valve tappet clearance on No. 6 cylinder to 0.021 in. (0.53 mm.) as instructed in Section 5.

Check the valve timing by turning the flywheel slowly in a clockwise direction (viewed from the front of the engine) and at the same time rotating the inlet valve push rod, as soon as the push rod is too tight to rotate freely, the inlet valve will be at opening point; the timing pointer on the flywheel housing should be in line with the appropriate mark on the flywheel, as quoted in the preceding paragraphs.

If the valve timing is incorrect and it is necessary to alter the vernier adjustment of the camshaft gear wheel, refer to the instructions given in Section 5, under "Valve Timing—To Check."

After obtaining the correct valve timing, secure the thrust button plate with locking wire, first ensuring that the securing setbolts are tightened to their correct torque loading as given in Section 33.

Adjust the valve tappet clearance to their original setting (*see Section 5*).

Fit the remaining parts in the reverse procedure for removal.

Renew the sealing washers fitted under the dished washers on the tappet inspection cover.

Check the camshaft end float, this is governed by the shims fitted under the head of the locating bolt in the front cover, for the correct dimension of the end float and available shims, *see Section 33*.

Check the adjustment of the drive belts (when fitted) (*see Section 15*).

Check the fuel-injection pump timing (*see Section 26 or 27*).

## Section 12

## TIMING GEAR IDLER WHEEL

### To Remove

Remove the crankshaft (*see Section 10*).

Remove the camshaft gear wheel (*see Section 11*).

Remove the engine support bracket on the horizontal engine, or cut the locking wire, remove the setscrews and take off the cover plate on the vertical engine which will expose the securing setscrews of the timing idler wheel.

Cut the locking wire and remove the setscrews.

The idler wheel assembly can then be lifted out through the engine casing.

### To Fit

Reverse the procedure given for removal.

Figure B20 clearly shows the construction of this unit; if the parts are assembled in the manner shown no difficulty will be experienced as provision has been made in the design to ensure that assembly cannot be carried out incorrectly.

For timing gear idler wheel end clearance (*see Section 33*).

Time the camshaft in accordance with Section 11 and the fuel-injection pump in accordance with Section 26 or 27.

## Section 13

## WATER PUMP

(See Figs. B23 and B24)

The following instructions are applicable to the engine mounted water pump. Refer to Part BA for the Drive Box mounted water pump.

**Note.**—If the water pump is being removed from an engine in situ, it may be necessary to remove the radiator (see Part A).

**To Remove**

Drain the cooling system (see Section 3).

When applicable, remove the fan from the water pump drive pulley.

On engines fitted with a header tank (see Fig. B23), remove the tank as follows:—

Remove the thermostat assembly complete (see Section 14).

Disconnect the overflow pipe, and the tank steady bracket secured to the valve cover.

Slacken the clips securing the hose connections; this is also applicable when a header tank is not fitted.

Remove the bolts securing the header tank support bracket to the bracket on the water pump, then lift off the tank complete.

Slacken and remove the alternator or dynamo and water pump drive belts (see Section 15).

Remove the nuts securing the water pump to the

engine casing and withdraw the water pump assembly complete.

**To Dismantle**

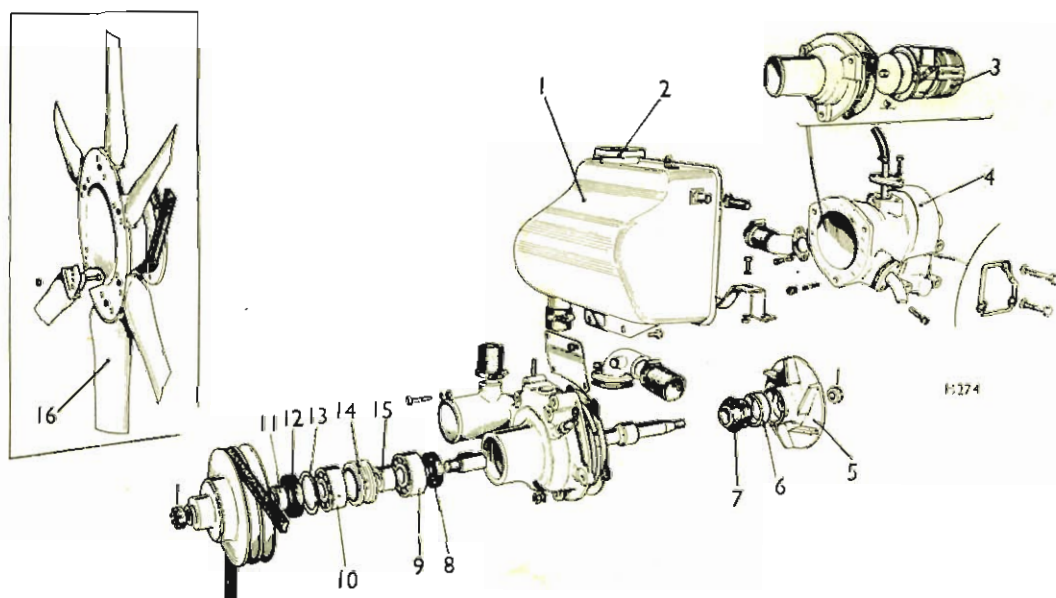
Remove the water pump spindle nut, drive pulley and key.

Unscrew the special nut from the smaller end of the spindle and draw off the impeller and gland assembly with the extractor tool listed in the Maintenance Equipment.

Remove the exposed oil seal and circlip from the pump body at the opposite end to the impeller, then with a lead hammer or a suitable drift drive out the spindle by tapping it on its smaller end, bringing with it the bearings, distance pieces and remaining oil seal.

Observe the position in which the oil seals are fitted in their housing (see Fig. B23) so that they can be refitted correctly.

Separate the gland assembly from the impeller, noting the position of the carbon seating.

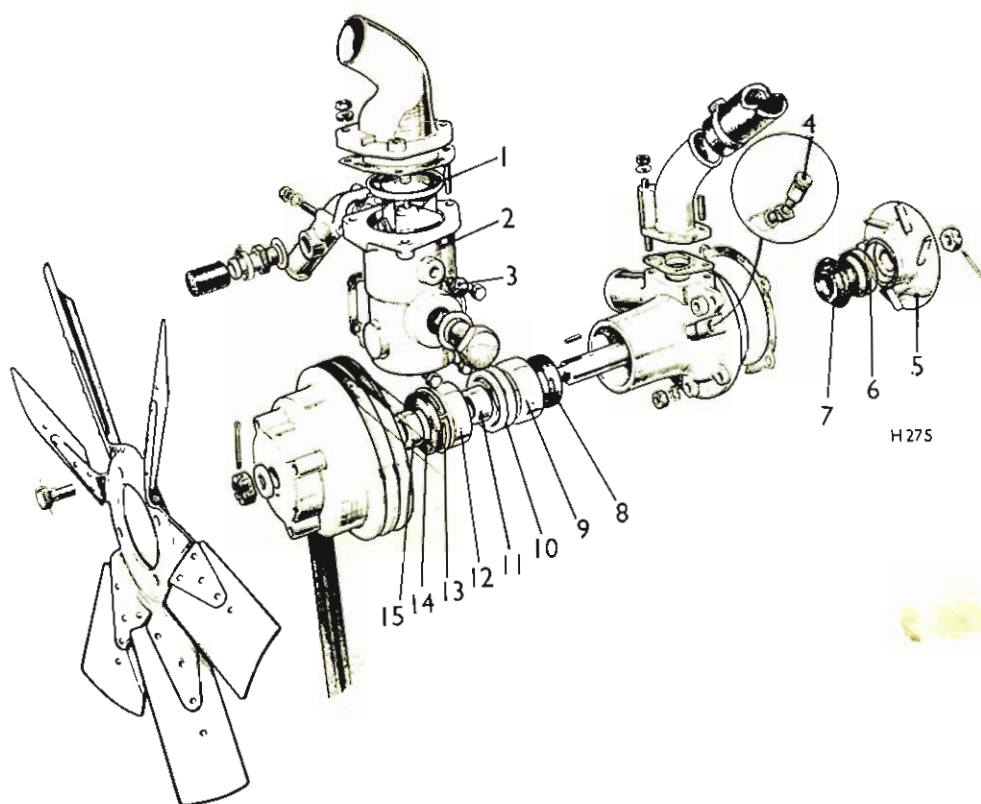
**Key to Numbers:—**

1. HEADER TANK
2. FILLER CAP INCORPORATING PRESSURE RELIEF
3. THERMOSTAT
4. BODY
5. IMPELLER

6. LINER (CONVERSION KIT ONLY)
7. GLAND ASSEMBLY
8. SMALL OIL SEAL
9. BALL BEARING
10. ROLLER BEARING
11. PULLEY DISTANCE PIECE

12. LARGE OIL SEAL
13. CIRCLIP
14. LARGE DISTANCE PIECE
15. SMALL DISTANCE PIECE
16. FAN ASSEMBLY—CRANKSHAFT MOUNTED

Fig. B23 Exploded view of water pump and header tank assembly



#### Key to Numbers:—

1. THERMOSTAT
2. BODY
3. DOWEL SCREW
4. LUBRICATOR
5. IMPELLER

6. LINER (CONVERSION KIT ONLY)
7. GLAND ASSEMBLY
8. SMALL OIL SEAL
9. BALL BEARING
10. LARGE DISTANCE PIECE

11. SMALL DISTANCE PIECE
12. ROLLER BEARING
13. CIRCLIP
14. LARGE OIL SEAL
15. PULLEY DISTANCE PIECE

Fig. B24 Exploded view of water pump and fan assembly  
— alternative to Figure B23

#### To Assemble

Assemble the parts in the reverse order to their removal noting the following points:—

When the wearing sleeve becomes worn it can be renewed; for details apply to any AEC Service Depot or Agent.

Check that the oil seals are in good condition, renew if necessary, insert the spindle into the housing, fit the small oil seal with the lip facing **inwards** followed by a ball bearing, the small and large distance pieces, the roller bearing the circlip, the large oil seal with the lip facing **inwards** and the remaining distance piece in that order. It is recommended that a **new circlip** is fitted.

Check that the face of both the carbon seat and the wearing sleeve in the pump body are not grooved or pitted, fit the gland assembly into the impeller, with the carbon seating facing **away** from the impeller then fit the complete assembly to the spindle, ensuring that the **special** nut securing the impeller on its taper is tightened to its correct torque loading and is locked with a **brass** split pin (*for torque spanner loading see Section 33*).

Finally fit the driving pulley.

#### To Fit

Reverse the procedure given for removal, ensuring that the correct belt tension is maintained (*see Section 15*).

## Section 14

## THERMOSTAT

The following instructions are applicable to the engine mounted thermostat. Refer to Part BA for the line mounted thermostat.

## Description

The operating temperature of the engine is controlled by a thermostat fitted in the water outlet pipe on the front cylinder head (see Fig. B6).

The thermostat assembly is shown in Figure B23 and consists of a metal bellows, secured at the bottom to a frame which fits into the thermostat body.

A valve is attached to the top of the bellows. A bleed hole in the head of the valve provides a release to prevent excessive pressure or steam accumulating in the cylinder casing or heads.

When the thermostat valve is closed, water is by-passed to the water pump through the by-pass port, thus confining the circulation to the cylinder block and heads.

When the temperature of the water reaches a predetermined figure, the thermostat valve starts to open and as the temperature rises, allows the water to circulate through the radiator.

## To Remove

Overheating of the engine may damage the valve and cause it to remain open permanently.

Should conditions indicate that the thermostat is not operating correctly remove the assembly as follows:—

Slacken the clips securing all hose connections to the thermostat body.

When applicable, disconnect the water temperature gauge connection.

Unscrew and remove the setbolts securing the thermostat body to the cylinder head and remove the thermostat assembly complete with water outlet pipe (see Fig. B23).

Remove the water outlet pipe by unscrewing the nuts securing it to the thermostat body.

Remove the dowel screw which locates the thermostat valve assembly in the body.

Refit the dowel screw after removing the assembly, to prevent loss.

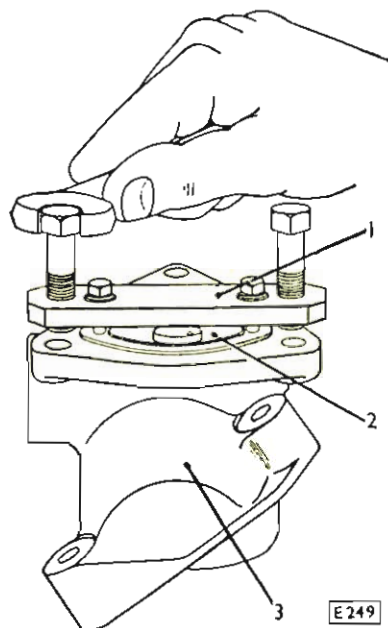
Withdraw the assembly with the withdrawal tool listed in the Maintenance Equipment (see Fig. B25).

## To Test

The thermostat valve assembly cannot be adjusted or dismantled.

Test for operating at correct temperatures as follows:—

See that the bellows and valve appear to be in good condition.



## Key to Numbers:—

1. WITHDRAWAL TOOL
2. THERMOSTAT ASSEMBLY
3. TYPICAL BODY

Fig. B25 Method of removing thermostat assembly from body (if fitted with extractor holes)

Hang the thermostat valve assembly and a thermometer in a bucket of water, so that they do not rest on the bottom, as this would cause a false reading.

Gradually heat the water and stir to ensure that the water and thermostat are at a uniform temperature, and take the temperature of the water while it is heating.

Between 175°F. and 185°F. (79°C. and 85°C.) or alternatively, between 160°F. and 170°F. (71°C. and 77°C.), the thermostat valve should begin to open.

It should be fully open between 190°F. and 200°F. (87°C. and 93°C.) or alternatively, between 175°F. and 185°F. (79°C. and 85°C.).

The maximum lift of the valve is  $\frac{3}{8}$  in. (9.52 mm.).

If the thermostat valve assembly does not function correctly, do not attempt to repair it, fit a new one.

## To Fit

Reverse the procedure for removal, ensuring that the dowel screw is located in the thermostat body, and all hoses are in good condition.

## Section 15

## DYNAMO OR ALTERNATOR

(See Figs. B3 and B6)

For the frame mounted dynamo or alternator, shaft driven from the Drive Box see Part BA

## Drive Belts—To Adjust

The dynamo or alternator adjusting link is located on the compressor drive housing, or alternatively, on certain **horizontal** type engines, on the right-angle drive housing.

On certain engines, **shims** are located between the alternator or dynamo **lugs** and the support bracket, to ensure correct alignment, **retain these shims**.

To adjust the drive belts, **slacken the unit hinge bolt(s)** or bracket retaining nuts, the adjusting bolt locknut, and when fitted, the securing strap.

Rotate the adjusting nut or bolt in the required direction to adjust the belts; **finally, tighten the hinge bolt(s)** or bracket nuts, locknut and **securing strap** (when fitted).

When applicable, on certain **horizontal** type engines, adjust the water pump drive belt by slackening the locking setscrews on the water pump drive pulley, then turn the front portion of the pulley in the required direction to adjust the belt.

When correctly adjusted there should be approximately 1 in. (25.4 mm.) total movement in the centre

of the vertical run of each belt, ensuring that there is no apparent slip after adjustment.

## To Remove

Slacken the drive belts as previously instructed.

If the engine is in situ, isolate the batteries and remove the terminal box cover and disconnect the cables.

Disconnect the belt adjustment linkage, then supporting the unit remove the hinge bolt(s) and lift away from its mounting.

On the cradle mounted unit, release the securing strap and remove the unit from the cradle.

To dismantle the unit see Part O.

## To Fit

Reverse the procedure for removal, ensuring that the correct belt adjustment is obtained, and that when fitted, the adjusting shims are in position.

After fitting the cables to the terminal box on the alternator, coat the harness protection sleeve with a non-hardening jointing compound and finally seal with three or four turns of copper wire.

## Section 16

## RIGHT-ANGLE FAN DRIVE UNIT (WHEN FITTED)

(See Figs. B3 and B26)

## To Remove

If the engine is in situ, disconnect the fan drive shaft from the drive unit coupling flange, and when fitted, the tachometer drive connection.

Release the drive belts (see Section 15).

Disconnect the drive belt adjusting mechanism

from the dynamo or alternator cradle.

Remove the securing nuts, release the water pipe support bracket, and remove the complete drive unit from its mounting.

When applicable remove the sandwich plate located between the unit and engine casing.

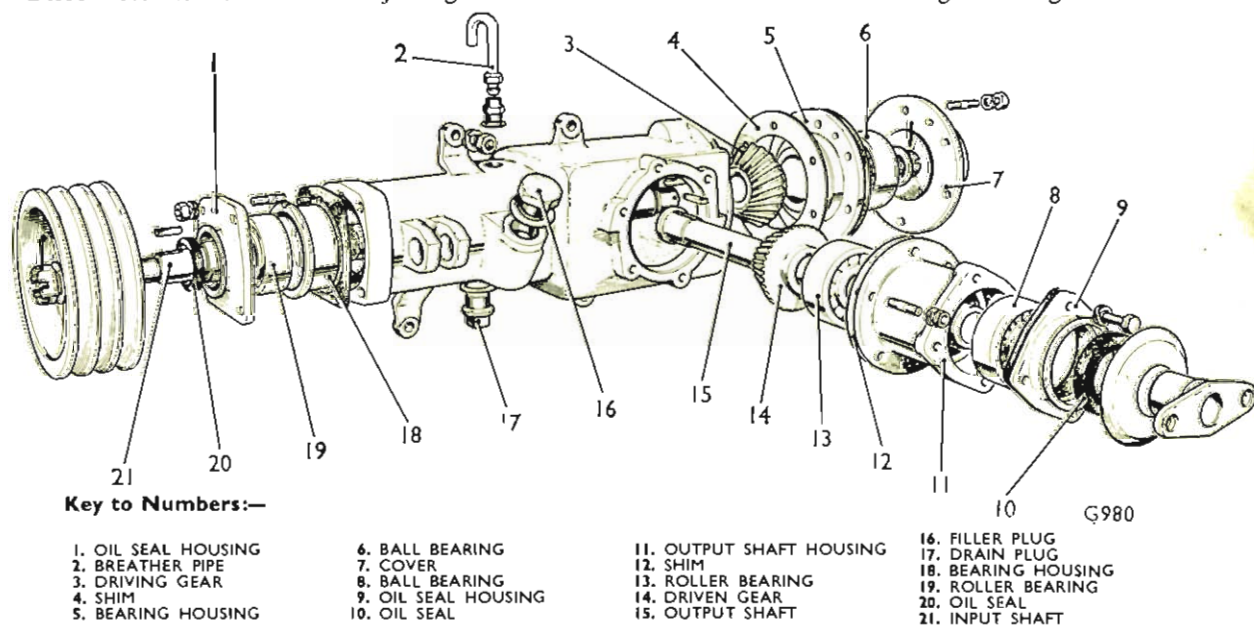


Fig. B26 Exploded view of right-angle fan drive unit

**To Dismantle**

Remove the drain plug and drain the oil into a suitable container.

Remove the breather pipe to prevent damage.

Remove the securing nut and withdraw the drive pulley from the input shaft, retain the key and distance piece.

Remove the cover from the opposing end of the input shaft and unscrew the bearing securing nut.

Screw two  $\frac{5}{16}$  in. U.N.F. setscrews into the withdrawal holes in the bearing housing and alternately rotating the setscrews, withdraw the housing; retain the shims located between the housing and unit casing.

Using a suitable drift at the coupling end, drive out the input shaft through the oil seal and roller bearing housings, withdraw the shaft complete with the driving gear from the casing; remove the gear from the shaft and retain the key.

Remove the securing nuts and withdraw the oil seal housing assembly, followed by the roller bearing inner race, then tap out the bearing housing complete with the outer race.

To dismantle the output shaft, proceed as follows:—

Remove the nuts securing the output shaft housing to the unit casing, and withdraw the shaft assembly complete; retain the shims located between the housing and casing.

Press out the output shaft from the coupling end and withdraw the coupling from the oil seal housing;

press the driven gear off the shaft and retain the key.

Remove the setscrews and detach the oil seal housing assembly; finally remove the bearings and distance piece.

**To Assemble**

Reverse the procedure of dismantling, noting the following points:—

Examine the oil seals and, if necessary, renew, ensure that oil seal assembly is in position before fitting the output shaft.

Check the input shaft driving gear adjustment; with the shaft assembled, the nominal shimming dimension between the unit casing and bearing housing is 0.015 in. (0.38 mm.), from this dimension, if the value as etched on the driving gear is negative, subtract the value from the nominal shimming, or alternatively, if positive, add the value.

Finally, by means of the shims fitted between the output shaft housing and the unit casing, check the backlash between the driving and driven gears (*for dimension of the backlash and shims available for both adjustments, see Section 33*).

**To Fit**

Reverse the procedure given for removal.

Fill the unit with fresh oil (*for approximate oil capacity see Part A*).

Check the adjustment of the drive belts (*see Section 15*).

**Section 17****COMPRESSOR (WHEN FITTED)**

(*See Figs. B27 and B38*)

**Description**

This unit is a two cylinder, single stage air cooled compressor and runs at one half the engine speed.

The drive is supplied from the timing gear idler wheel to a gear on the compressor crankshaft, or alternatively, the compressor is located on the right-hand side of the engine, and driven from the camshaft gear.

Its cylinder block and crankcase are formed from a single casting; and the cylinder head, which is common to both cylinders, is provided with cooling fins.

Inlet and delivery valves, a pair to each cylinder are incorporated in the detachable cylinder head. The valves consist of lapped steel discs, spring loaded against removable seats.

The inlet valve seats, guides and discs are retained in position by means of valve keepers pressed into the face of the cylinder head.

The delivery valve seats are screwed into the cylinder head, the discs and springs being retained by the cap nuts, one of which embodies the safety valve, which protects the system should the unloader valve fail to operate.

Each piston is provided with two compression rings above the gudgeon pin and a scraper ring in the lower portion of the piston skirt. The pistons are secured to the connecting rod by fully-floating gudgeon pins, secured at each end by a circlip.

Split type bearings are fitted at the big-end and bronze bushes for the gudgeon pins.

**Maintenance**

Normally, the only maintenance required is at vehicle overhaul periods.

At periods quoted in Part A, a check should be made of the time required to charge the reservoir to full pressure as this, if it becomes excessive, may

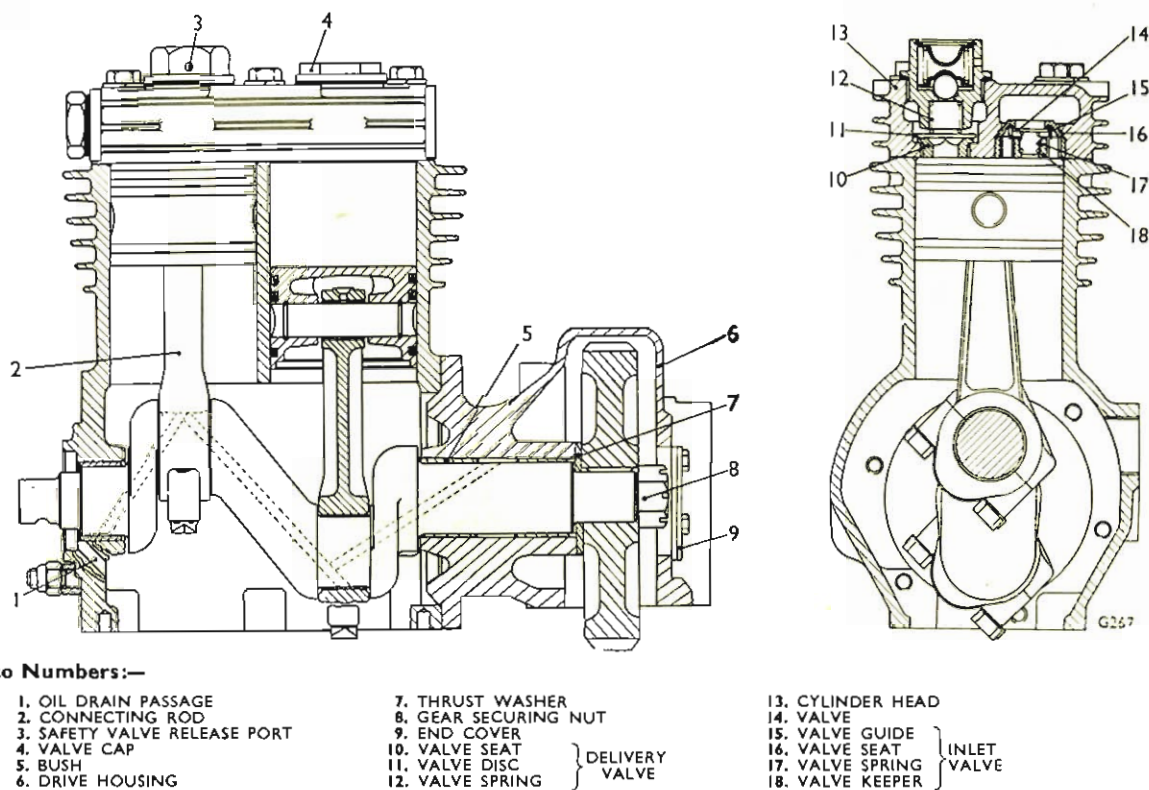


Fig. B27 Section and arrangement of twin cylinder compressor

indicate a compressor defect.

Check all joints and unions for leakage or slackness and tighten if necessary, if the cylinder head has recently been removed, ensure that the securing bolts are tightened to a torque loading of 12 lb. ft. (1.6 Kg. M.).

Remove the delivery valve caps and check for the presence of carbon, if excessive, remove the cylinder head as instructed under "To Dismantle" and thoroughly clean all parts, care should be taken to ensure that no dirt enters the safety valve body through the release port.

Check the valves and seats for leakage, any excessive leakage can be remedied by cleaning and lapping or renewing the valves and/or seats.

If leakage is apparent at the safety valve release port, it will necessitate renewing the complete valve cap and safety valve assembly.

Check and clean the oil supply pipe.

#### To Remove

Release all air pressure from the system.

Before removing the compressor it is advisable to set the fuel-injection pump on the correct timing mark on the engine flywheel (see Section 1).

When applicable, and if the engine is in situ, support the weight of the engine from beneath and disconnect the compressor drive housing from the left-hand engine mounting, also release the inlet and delivery pipes.

Disconnect the oil feed pipe.

Remove the fuel-injection pump (see Section 26).

When fitted, remove the drive belt adjustment linkage.

Remove the setscrews securing the compressor drive housing to the engine casing, and lift off the compressor complete with housing and when applicable, retain the spring and sealing ring on the oil return tube.

#### To Dismantle

Thoroughly clean the exterior of the unit and mark the following items to ensure correct assembly; the position of the cylinder head in relation to the cylinder block, the end cover and drive housing relative to the crankcase, and finally, the crankshaft to the crankcase, and the safety valve to the cylinder head; seal the safety valve release port before cleaning.

Remove the base cover and joint.

Remove the bolts securing the cylinder head; lift

off the head and gasket, it may be necessary to tap the head with a rawhide hammer to break the joint.

Unscrew the setscrews, remove their spring washers and release the end cover from the drive housing. Remove the split pin, drive nut and washer.

Mark the connecting rods and their corresponding caps, release the locking plate and remove the caps. Withdraw the piston and connecting rod assemblies through the top of the cylinder bores.

If necessary, the piston can be removed from the connecting rod by releasing one of the circlips and pressing out the gudgeon pin, finally remove the piston rings.

Remove the fuel-lift pump housing (*see Section 25*).

Remove the nuts and washers securing the drive housing to the crankcase. Withdraw the housing with the crankshaft; hold the drive gear and thrust washer and then remove the housing from the shaft, retain the keys.

### To Dismantle the Cylinder Head

Unscrew the delivery valve caps; withdraw the valve springs and discs.

**Do not dismantle the safety valve.**

To withdraw the delivery valve seats use the tool listed in the Maintenance Equipment. Similarly, a tool is listed in the Maintenance Equipment for withdrawing the inlet valve spring keepers. The inlet valve springs and discs can then be removed.

### To Overhaul

It is essential that all parts are cleaned and protected from dust and grit while awaiting assembly.

**Cleanliness of all parts is of the utmost importance.**

Remove all carbon deposits from the cylinder head, the delivery valve springs and discs.

Check the cylinder bores for scoring and excessive wear, if the scoring and wear of the bore diameter should exceed 0.002 in. (0.51 mm.) or tapered more than 0.003 in. (0.076 mm.), a rebore will be necessary.

The standard clearance of the pistons in the bores is 0.0025 in. to 0.004 in. (0.063 mm. to 0.102 mm.).

The instructions given in the following paragraph should be adhered to when the cylinder bores have worn to any one of the following limits:—

+ 0.005 in. (0.127 mm.)—fit new standard rings;  
+ 0.005 in. to 0.010 in. (0.127 mm. to 0.254 mm.)—bore out to + 0.010 in. (0.254 mm.) and fit new 0.010 in. (0.254 mm.) oversize pistons and rings; + 0.015 in. (0.381 mm.)—fit new 0.010 in. (0.254 mm.) oversize rings; + 0.015 in. to 0.020 in. (0.381 mm. to 0.508 mm.)—bore out to + 0.020 in. (0.508 mm.) and fit new 0.020 in. (0.508 mm.) oversize pistons and rings;

+ 0.025 in. (0.635 mm.)—fit new 0.020 in. (0.508 mm.) oversize rings; + 0.025 in. to 0.030 in. (0.635 mm. to 0.762 mm.)—bore out to + 0.030 in. (0.762 mm.) and fit new 0.030 in. (0.762 mm.) oversize pistons and rings; + 0.035 in. (0.89 mm.)—fit new 0.030 in. (0.762 mm.) oversize rings.

Inspect the pistons, renew if scored or damaged check the piston ring gaps and groove clearance; the ring gap should be 0.003 in. to 0.007 in. (0.076 mm. to 0.178 mm.) and the groove clearance 0.0005 in. to 0.0025 in. (0.012 mm. to 0.063 mm.).

Check the clearance of the gudgeon pin in the piston and small end bush, the pin must be a light press fit in the piston, and should not exceed 0.0015 in. (0.048 mm.) clearance in the bush; if necessary, renew the piston and gudgeon pin.

Inspect the crankshaft for wear, the crankpin diameters should be within the limits of 1.2495 in. to 1.2490 in. (31.74 mm. to 31.72 mm.).

Check the bearings for correct fit on the crankshaft journals, the clearance between the connecting rod journals and the bearings must not be less than 0.0005 in. (0.012 mm.) and not more than 0.004 in. (0.102 mm.).

Check the cylinder head, inlet and delivery valves and seats for damage, if the valves are grooved deeper than 0.003 in. (0.076 mm.) where they contact the seat, they should be renewed. Valves and seats not badly damaged may be relapped.

Examine the plain bushes in the drive housing and in the non-driving end of the crankcase for wear or scoring.

### To Assemble

Clean and lubricate all moving parts and the cylinder walls with clean engine oil, reverse the dismantling sequence, paying attention to the following instructions:—

If the piston has been removed from the connecting rod fit the gudgeon pin and secure with the circlips, it is advisable to fit new circlips.

Fit the piston rings, ensuring that when applicable, the sides marked "Top" are uppermost.

Insert each connecting rod and piston assembly into the top of the cylinder bore from which it was removed.

Mount the crankshaft in the drive housing; fit the drive gear and thrust washer with the chamfered inner edge of the washer towards the plain bearing.

Place the washer on the driving end of the crankshaft; screw on the drive nut and lock with a new split pin.

Insert the crankshaft into the cylinder block. Secure the drive housing to the cylinder block after fitting a new packing joint between the faces.

Fit the fuel-lift pump housing (see Section 25).

Locate the connecting rods on their respective crankshaft bearings. Place the correct cap (marked on dismantling) on its connecting rod, and secure the rods to the crankshaft, a new locking plate should be fitted and the connecting rod bolts tightened to a torque loading of 3.75 to 4 lb. ft. (0.52 to 0.55 Kg. M.), bend the tabs of the locking plate after securing the bolts.

Fit the driving-end cover plate to the drive housing using the setscrews and spring washers after placing a new packing joint between the faces.

Secure the base plate after fitting a new packing joint.

#### To assemble the cylinder head:—

New inlet valve discs and springs should be located in their respective positions and the inlet valve keepers then pressed in.

Fit the delivery valve seats; place the delivery valve discs in position. Fit the spread coil of the delivery valve spring into the valve cap; assemble the cap and copper washer.

Check the delivery valve seats for leakage, connect an air pressure supply of 100 lb. per sq. in. (7.03 Kg. per sq. cm.) to the delivery port, apply a solution of soapy water to the valve seats in the face of the cylinder head; leakage in excess of a one inch soap bubble in five seconds is not permissible.

Leakage can probably be cured by tapping the delivery valves off their seats several times with the air pressure applied, taking care not to damage the valves.

Place a new gasket on the seating and secure the

cylinder head to the compressor, the cylinder head securing bolts should be tightened progressively to a torque loading of 12 lb. ft. (1.6 Kg. M.).

#### To Test

**Note.**—It is recommended that the pumping-up times for given engine speeds are taken when the compressor is first placed in service. These figures will provide a useful check on the efficiency at any future date after overhaul.

After assembly the compressor should be run and should perform as indicated in Part K, or alternatively, according to the capacity of the air reservoir. If the performance falls below that required, check that there are no leaks from the reservoir, reservoir valves or piping. If these are in order, the instructions given under "To Overhaul" must be given further attention.

#### To Fit

If the engine has not been rotated, refit the compressor with the fuel-injection pump drive coupling in its original position.

If the engine has been rotated set the engine fly-wheel at 10° before the T.D.C. No. 1 mark, and fit the compressor.

Fit the remainder of the parts in the reverse order to their removal, ensuring that the correct backlash is obtained between the timing gear idler wheel or camshaft gear and the compressor driving gear. This is governed by the number of joints fitted between the driving gear housing and the engine casing (*For the correct backlash, see Section 33*).

Finally, check the fuel-injection pump timing (see Section 26 or 27).

## Section 18

## STARTER MOTOR

(See Fig. B7)

#### To Remove

If the engine is in situ, isolate the batteries.

Disconnect the cables from the starter motor terminals.

Remove the nuts and washers securing the starter motor flange to its mounting, then withdraw the unit.

#### To Fit

Reverse the procedure for removal ensuring that the starter motor is positioned as shown in Figures B4 and B7.

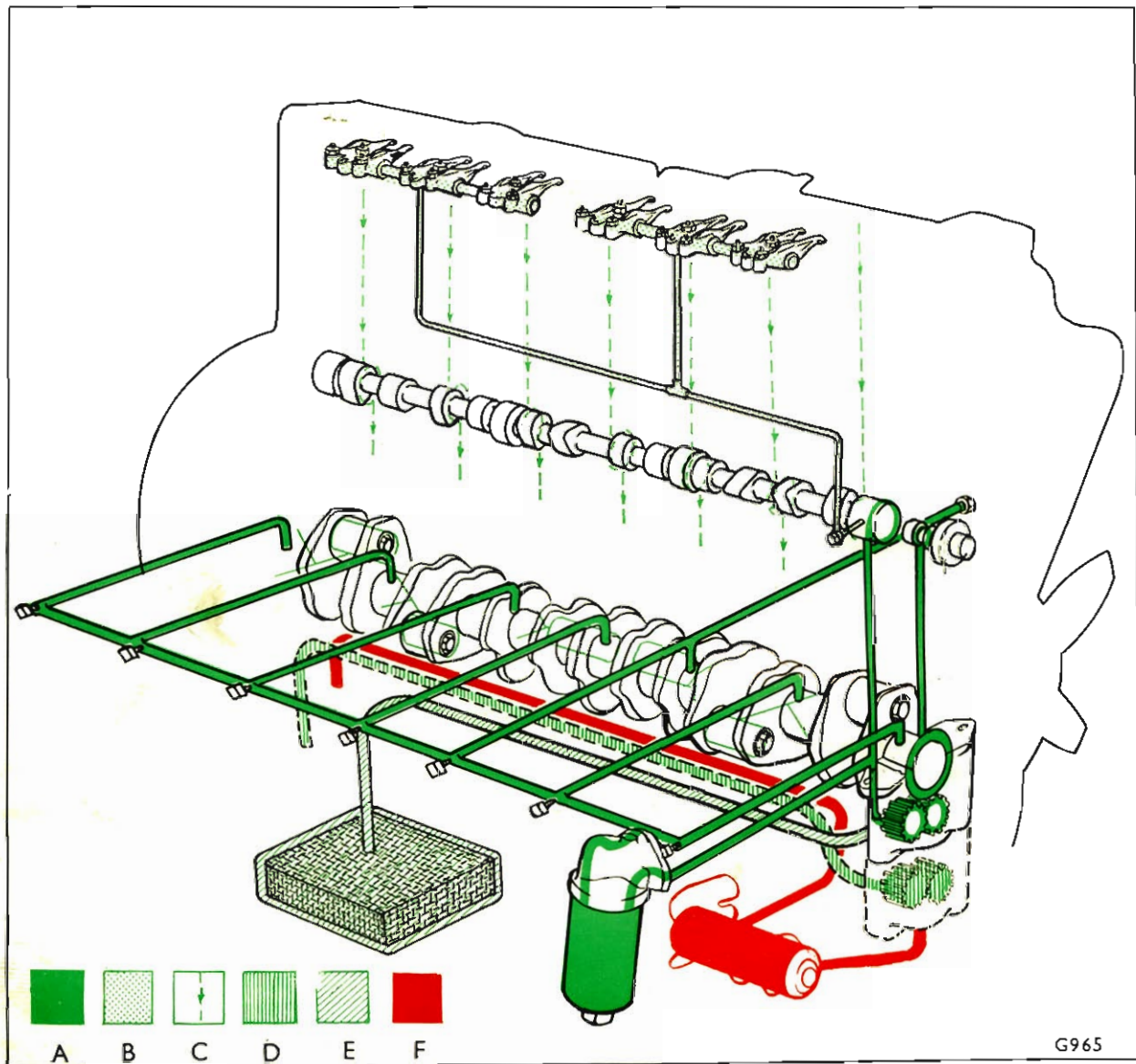
To dismantle the starter motor see Part O.

## Section 19

## LUBRICATION

The engine is lubricated on the wet sump principle, lubrication under pressure being effected by a gear type pump incorporated in the No. 1 main bearing cap, and driven by a gear wheel from the crankshaft; the oil circulating pump (when fitted) is located immediately beneath No. 1 main bearing cap.

Oil is drawn through a protective gauze strainer and passed to the external oil filter, whence it is delivered to the main bearings, connecting rod big-end bearings, timing gear idler wheel and the camshaft No. 1 bearing.



**Key to Letters:—**

- A. HIGH PRESSURE OIL SUPPLY
- B. LOW PRESSURE OIL SUPPLY
- C. "SPASH"
- D. CIRCULATING SYSTEM (WHEN FITTED)
- E. OIL IN SUMP
- F. OIL COOLER (WHEN FITTED)

**Fig. B28** Diagrammatic view of typical vertical engine lubrication system

A low pressure oil supply is metered through the camshaft front bearing journal to supply the hollow rocker shafts and rocker pads.

Pistons, gudgeon pins, tappets and camshaft bearings, except the camshaft front bearing are lubricated by "splash".

Surplus oil drains through the engine to the sump, to be drawn through the gauze strainer and circulated into the system or alternatively, is drawn up by the circulating pump (when fitted) passes through the oil cooler and returns to the main reservoir of the sump to be used on the pressure side.

A pressure relief valve is incorporated in the pressure

side of the system; this valve by-passes the oil into the sump when excessive pressure is reached, the valve is **pre-set and on no account should be altered**, if any trouble is experienced, it is advisable to contact any AEC Depot or Agent.

When new, on **early type** engines, the correct pressure, with the engine **HOT**, should be 30 lb. per sq. in. (2.1 kg. per sq. cm.) **minimum** at a speed of 1,800 r.p.m., the pressure will vary in accordance with the wear of the engine. On **late type** engines, the relief valve is set to ensure a **minimum** pressure of 55 lb. per sq. in. (3.9 Kg. per sq. cm.) at 1,800 r.p.m.

The engine casing is vented to atmosphere through a suitably mounted breather.

## Section 20

### OIL PUMP(S)

(See Figs. B29 and B31)

#### To Remove

Remove the sump (see Section 6), or the engine casing extension (see Section 7), whichever is applicable.

Remove the oil suction pipe from the oil pressure pump, and when fitted the pipe from the oil circulating pump.

Remove the setscrews from No. 1 main bearing cap, carefully remove the oil circulating pump (when fitted) and the bearing cap together with the pressure pump.

Detach the bearing from the cap, to avoid any possible damage which may occur when dismantling the oil pressure pump.

#### To Dismantle

**Note.**—The following instructions are applicable to both the oil pressure pump, and, when fitted, the oil circulating pump.

Remove the nut and lockwasher securing the helical gear to the spindle.

Remove the helical gear from its taper by means of the drawdog listed in the Maintenance Equipment.

Take out the key and remove the setscrews securing the oil pump cover.

Tap the cover off its dowels and extract the gears.

#### To Assemble

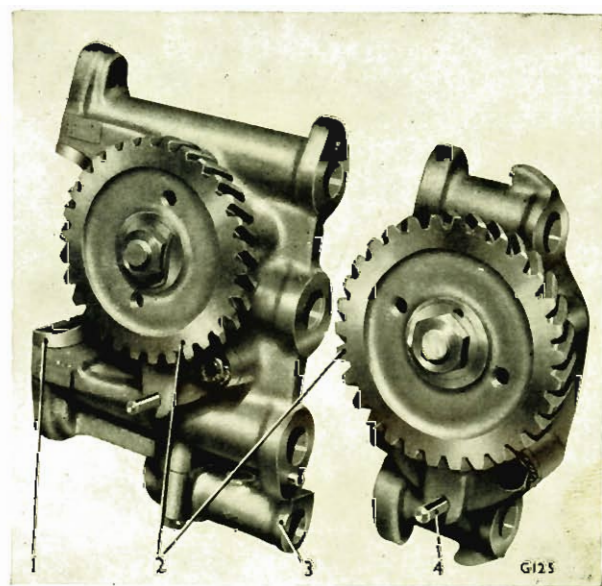
Wash all parts in clean paraffin before assembling and observe that all oil-ways are clear.

Fit the parts in the reverse order to their removal. No joint is used between the pump body and cover. Fit the key to the spindle and attach the helical gear, locking the nut with a lockwasher, the nut should be tightened to its correct torque loading as given in Section 33.

After assembly, the pump should be capable of being turned smoothly and without effort.

#### To Fit

Reverse the procedure for removal, ensuring that the main bearing cap setscrews are tightened correctly. (For torque spanner loadings, see Section 33).



#### Key to Numbers:—

- |                  |                              |
|------------------|------------------------------|
| 1. MAIN BEARING  | 3. OIL PRESSURE RELIEF VALVE |
| 2. HELICAL GEARS | 4. LOCATING DOWEL            |

Fig. B29 Method of fitting oil pressure and circulating pumps

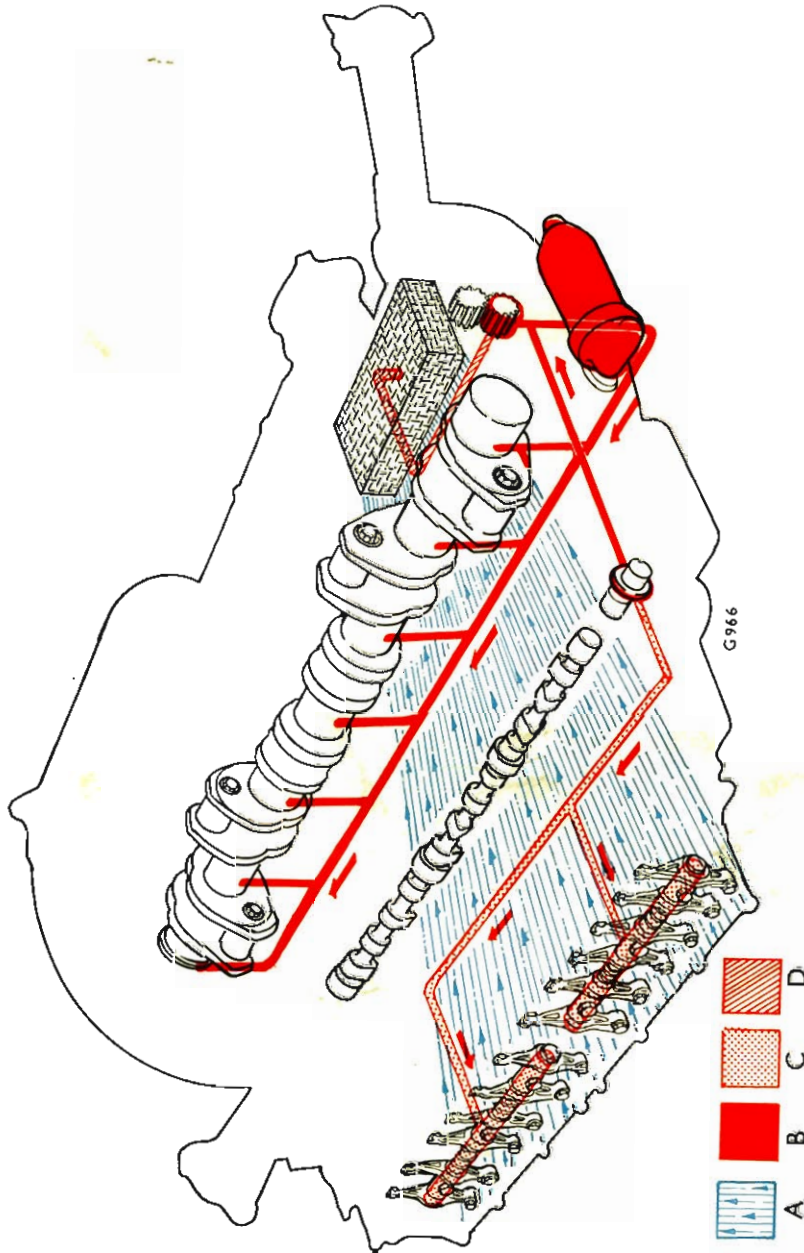
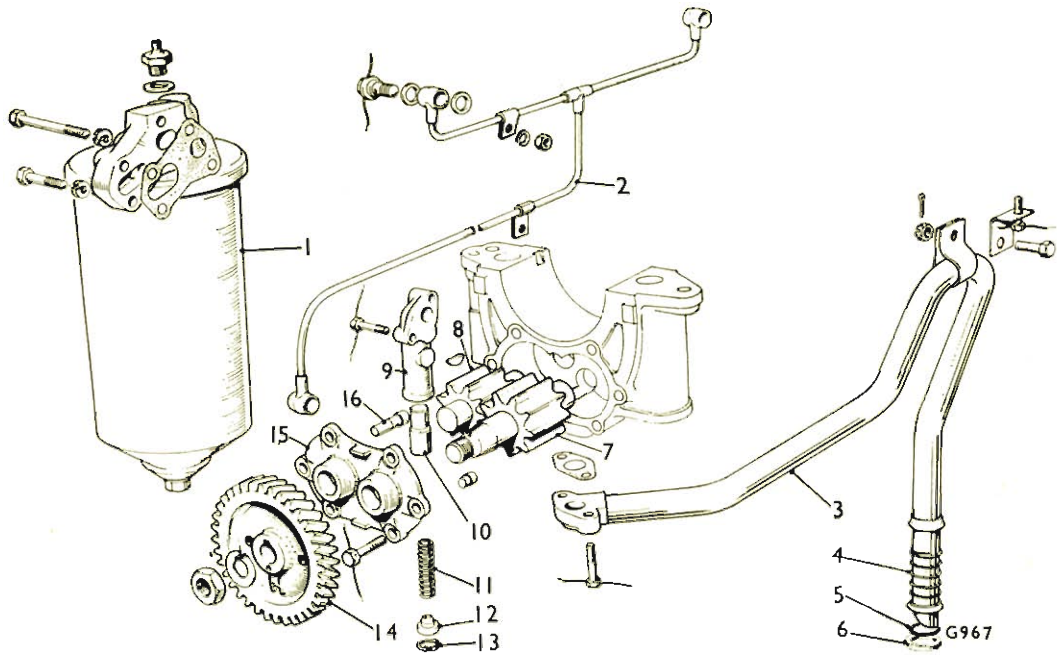


Fig. B30 Diagrammatic view of typical horizontal lubrication system



**Key to Numbers:—**

- |                                  |                           |                                |
|----------------------------------|---------------------------|--------------------------------|
| 1. OIL FILTER                    | 9. BODY                   | } OIL PRESSURE<br>RELIEF VALVE |
| 2. OIL SUPPLY PIPE—VALVE ROCKERS | 10. PLUNGER               |                                |
| 3. OIL SUCTION PIPE              | 11. SPRING                |                                |
| 4. SPRING                        | 12. SPRING STOP           |                                |
| 5. 'O' RING                      | 13. CIRCLIP               |                                |
| 6. FELT WASHER                   | 14. EXTERNAL DRIVING GEAR |                                |
| 7. DRIVING GEAR                  | 15. COVER                 |                                |
| 8. DRIVEN GEAR                   | 16. LOCATING DOWEL        |                                |

**Fig. B31 Exploded view of oil pump assembly**

## Section 21

## OIL COOLER (WHEN FITTED)

### To Dismantle

The oil cooler is designed to eliminate maintenance. If, however, at overhaul periods it is found necessary to dismantle the cooler proceed as follows:—

Remove the tube stack retaining screws at each end of the cylinder.

Remove the rubber sealing rings by pressing the tube stack out of its housing approximately  $\frac{3}{4}$  in. (19 mm.) in either direction.

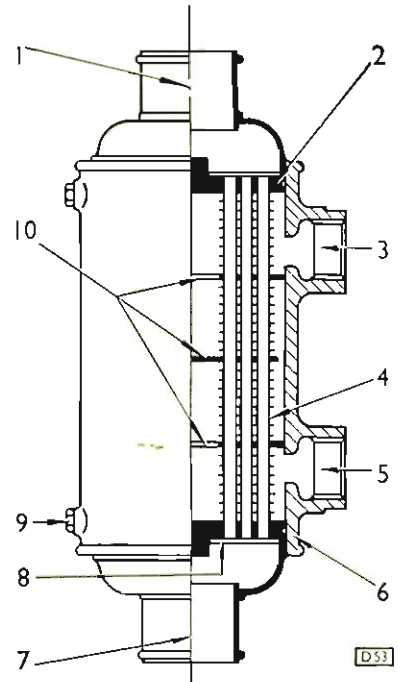
Each movement will expose a rubber sealing ring which must be removed before completely removing the tube stack.

### To Assemble

Reverse the procedure for dismantling, renewing the rubber sealing rings if necessary.

### Key to Numbers:—

- |                     |                               |
|---------------------|-------------------------------|
| 1. WATER INLET      | 6. CASING                     |
| 2. SEALING RING     | 7. WATER OUTLET               |
| 3. OIL OUTLET       | 8. TUBE PLATE                 |
| 4. FLOW GUIDE PLATE | 9. TUBE STACK RETAINING SCREW |
| 5. OIL INLET        | 10. BAFFLE PLATES             |



**Fig. B32 Section through oil cooler**

## Section 22

## FULL-FLOW OIL FILTER

(See Figs. B31 and B33)

## Key to Numbers:—

1. FILTER HEAD
2. PAPER FILTER ELEMENT
3. WASHER
4. RETAINING SETSCREW
5. CUP WASHER
6. ELEMENT RETAINING SPRING
7. WASHER
8. WASHER
9. ELEMENT SEATING
10. BOWL
11. JOINT "O" RING
12. RELIEF VALVE

## Description

The oil filter consists of an aluminium head supporting a steel bowl containing the plastic impregnated paper filtering element; a relief valve is incorporated in the filter head to ensure a continuous flow of oil, should the element be allowed to get completely choked through neglect.

## Maintenance

At intervals quoted in Part A the filter should be given the following attention:—

Remove the oil pressure gauge or switch connection (when fitted) and detach the oil filter from the engine by removing the securing setscrews which pass through the oil filter head.

Unscrew the setscrew at the base of the oil filter and remove the bowl and filtering element.

Renew the element and thoroughly wash the remaining parts in clean paraffin and allow them to drain.

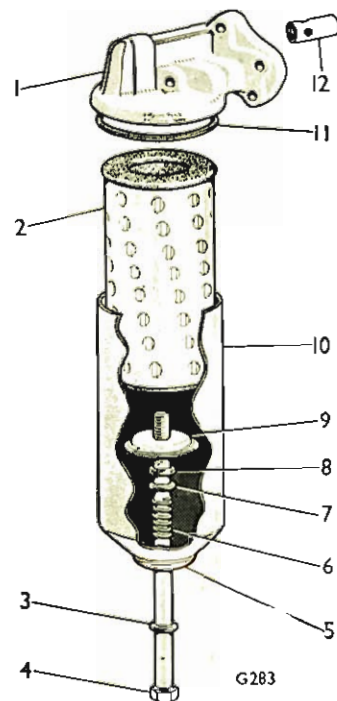


Fig. B33 Section through a typical full-flow type oil filter

Reverse the procedure for removal ensuring that a 0.015 in. (0.38 mm.) thick sealing joint is fitted between the oil filter head and its mounting.

## Section 23

## AIR CLEANER

## Maintenance

Alternative types of Oil Bath cleaners can be fitted as shown in Figures B34 and B36.

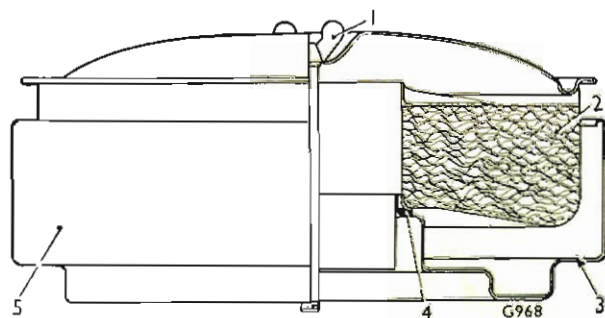
The air cleaner is either mounted on to the engine air intake, or frame mounted with suitable trunking connecting it to the air intake.

At intervals quoted in Part A:—

On the type shown in Figure B34, unscrew the wing nut on the top of the air cleaner, and lift off the cleaner complete, taking care not to spill the oil contained in the bowl, retain the sealing ring.

Remove the combined top cover and filter element.

Wash the element thoroughly in clean paraffin and allow to drain.



## Key to Numbers:—

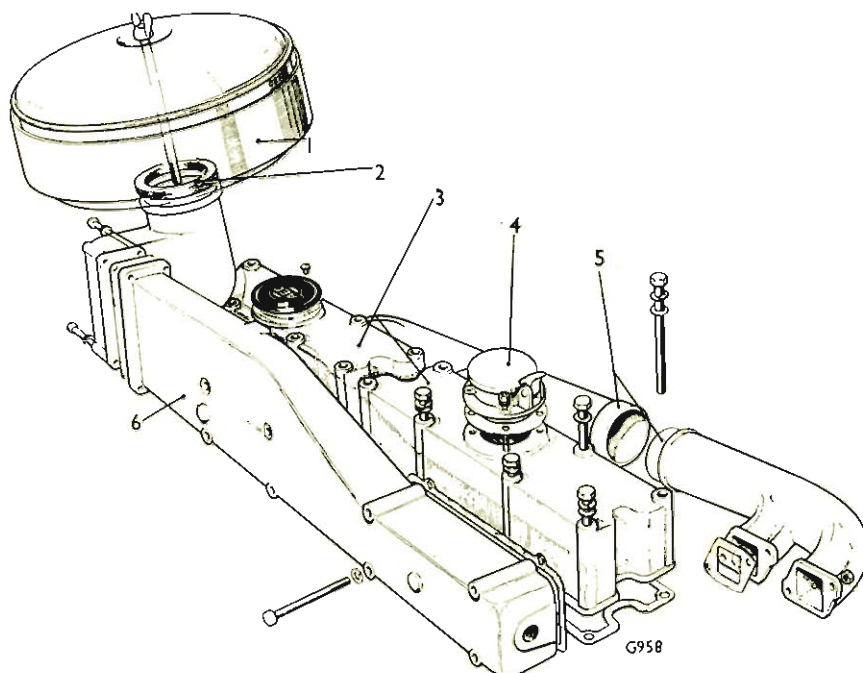
1. SECURING STUD
2. ELEMENT

3. OIL LEVEL
4. SEALING RING
5. BASE PORTION

Fig. B34 Section through typical air cleaner

**Key to Numbers:—**

1. AIR CLEANER
2. SEALING RING
3. VALVE COVER
4. OIL FILLER
5. EXHAUST MANIFOLD
6. AIR INTAKE



**Fig. B35 Exploded view of valve covers and air intake assembly**

Drain all oil from the base portion, clean and refill with clean engine oil to the level mark.

Fit the parts in the reverse order to their removal, checking that all joints and sealing rings are in good condition, renew if necessary.

On the air cleaner shown in Figure B36, slacken the securing clip and remove the pre-cleaner from the top or side of the main body.

When fitted with a top-mounted pre-cleaner, release the clips securing the dome shaped cover, lift off the cover and drain out the oil from the pre-cleaner.

Wash thoroughly, both types of pre-cleaners in clean paraffin and allow to drain.

Release the base portion of the cleaner by releasing the securing clips, taking care not to spill the oil.

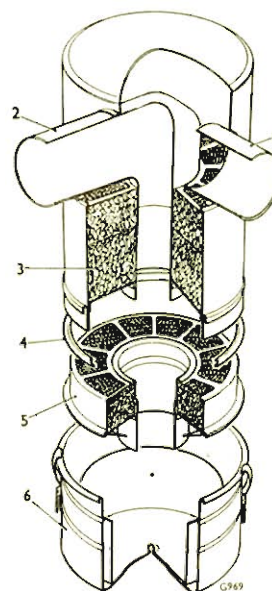
Remove the element and drain out the oil, thoroughly wash the base portion and element in clean paraffin, including the second portion of the element in the main body and allow to drain.

Fit the parts in the reverse order to removal, ensuring that all sealing joints are in good condition, renew if necessary, then proceed as follows:—

Fit the removable element into the main body checking that it is located correctly on the centre tube, then fit the base portion, ensuring that the element has not dropped and become twisted.

Fill the base portion and when applicable, the top-mounted pre-cleaner, with clean engine oil up to the level marks (*for approximate capacity and oil specification, see Parts A and S*).

**Note:**—Certain air cleaners are fitted with a paper filter element; when cleaning, this element should be dispensed with and a new one fitted.

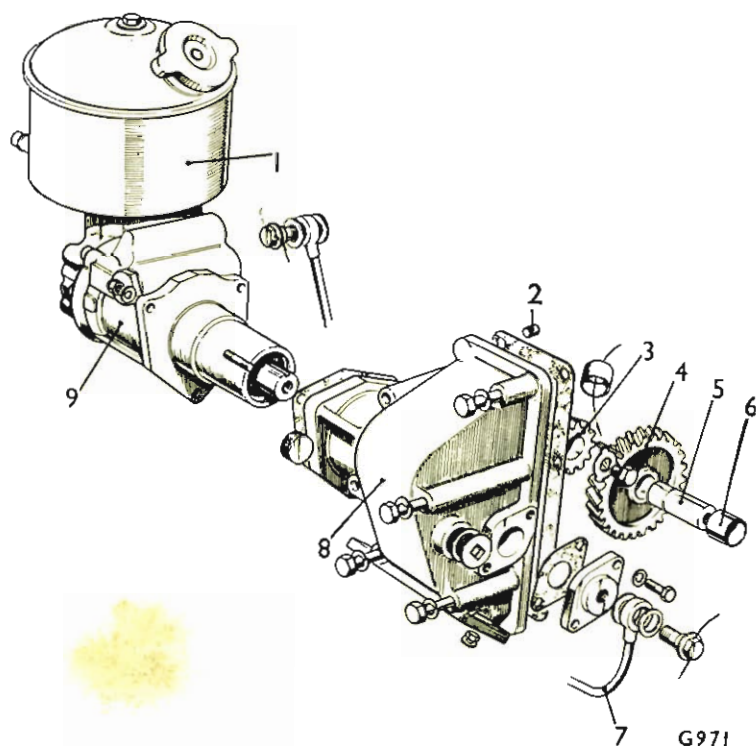
**Key to Numbers:—**

1. AIR OUTLET
2. AIR INLET
3. COMBINED BODY AND ELEMENT
4. SEALING RING
5. REMOVABLE ELEMENT
6. BASE PORTION

**Fig. B36 Section through typical "two stage" air cleaner**

## Section 24

## HYDRAULIC PUMP DRIVE (WHEN FITTED)



## Key to Numbers:—

- 1. SUPPLY TANK
- 2. LOCATING DOWEL
- 3. PUMP GEAR
- 4. IDLER GEAR

- 5. IDLER SHAFT
- 6. BUSH
- 7. OIL SUPPLY PIPE
- 8. DRIVE HOUSING
- 9. HYDRAULIC PUMP

Fig. B37 Exploded view of hydraulic pump drive

**To Remove**

Remove the hydraulic pump (see Part F).

Remove the bolts securing the drive housing to the engine casing and lift off the housing, complete with the pump.

**To Fit**

Reverse the procedure of removal, ensuring the casing dowels are located correctly and that the correct backlash is obtained between the camshaft gear and the drive housing idler gear. This is governed by the number of joints fitted between the housing and the engine casing (*for correct backlash see Section 33*).

## Section 25

## FUEL INJECTION PUMP DRIVE

Before dismantling the fuel-injection pump drive, it is advisable to set the engine flywheel on the correct degrees for the fuel-injection pump timing, as instructed in Section 26.

**Note:**—The following instructions are applicable when a “Distributor” type pump is fitted (see Fig. B38); the “In-line” type pump drive (see Fig. B41) is

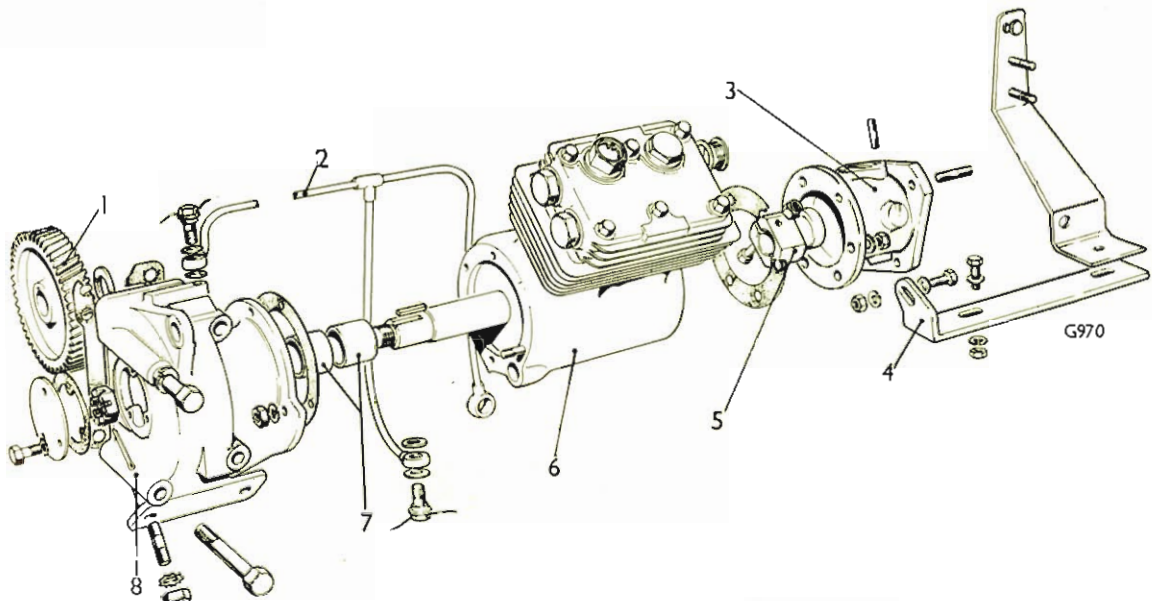
dismantled in conjunction with the air compressor as instructed in Section 17.

**To Remove**

Remove the fuel-injection pump (see Section 26 or 27).

Remove the fuel-lift pump (see Section 30).

Detach the oil feed pipe connections from the fuel-lift pump housing and compressor drive housing.



**Key to Numbers:—**

- |                    |                                       |                   |
|--------------------|---------------------------------------|-------------------|
| 1. DRIVING GEAR    | 3. FUEL-LIFT PUMP HOUSING             | 6. AIR COMPRESSOR |
| 2. OIL SUPPLY PIPE | 4. FUEL-INJECTION PUMP STEADY BRACKET | 7. BUSHES         |
|                    | 5. DRIVE COUPLING                     | 8. DRIVE HOUSING  |

**Fig. B38 Exploded view of compressor and fuel-injection pump drive**

Remove the nuts and washers securing the fuel-lift pump housing to the compressor housing, or whichever alternative unit is fitted, also remove the bolt securing the housing to the engine mounted steady bracket, and ease the housing off from its mounting.

Removal of the lift pump housing will expose the drive coupling, secured by a key and pinch bolt to the compressor or alternative unit drive shaft, slacken the pinch bolt and withdraw the coupling from the drive shaft.

**To Fit**

Reverse the procedure of removal noting the following points:—

Ensure that the drive coupling is fitted correctly on the keyway and secured with the pinch bolt.

Fit the fuel-lift pump housing, ensuring that the aperture for the lift pump is at the top.

Check that all joints are in good condition, renew where necessary, tighten all unions securely, finally check the fuel-injection pump timing (see Section 26 or 27).

## FUEL-INJECTION SYSTEM

### Section 26

### FUEL-INJECTION PUMP—"DISTRIBUTOR" TYPE

(See Figs. B3, B6 and B39)

**Description**

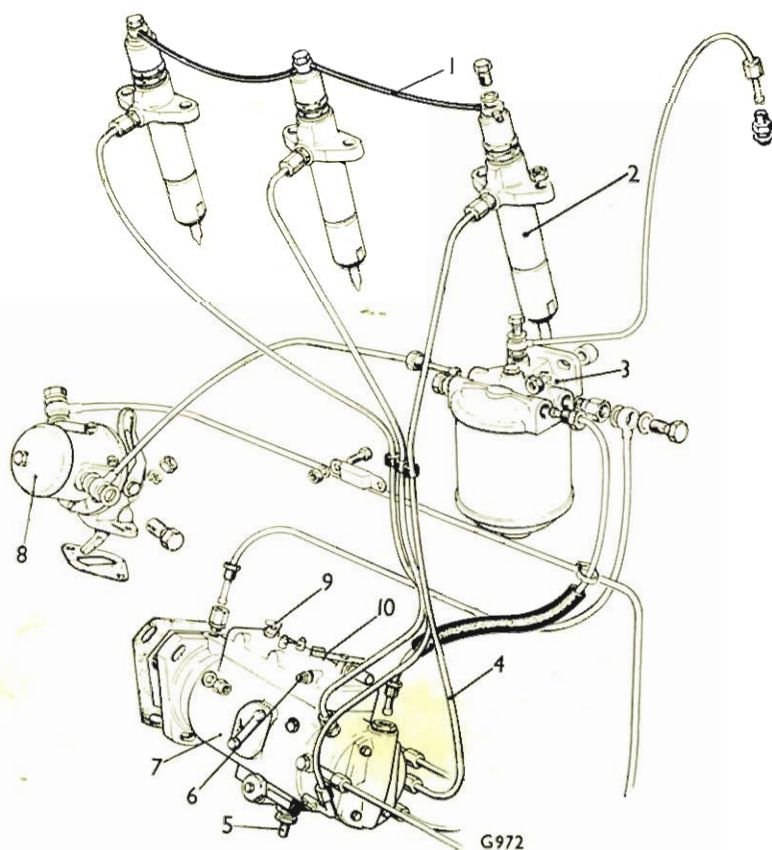
The distributor type fuel-injection pump is a compact, oil-tight unit, lubricated throughout by fuel oil and requires no separate lubrication system.

The fuel is pumped by a single element, and is injected at the required timing intervals, in the correct firing order to each cylinder in turn, by means of the rotary distributor, which is integral with the pump.

The pump is fully automatic, incorporating an all-speed mechanical type governor and an automatic advance unit.

An easy starting device (when fitted) is located on the pump, as shown in Figure B39 and is operated by a sideways movement of the lever.

Ensuring that the instructions for maintaining and servicing the main fuel filter(s) and the injectors are



#### Key to Numbers:—

1. INJECTOR GALLERY PIPE
2. FUEL INJECTOR
3. FUEL FILTER
4. FUEL DELIVERY PIPE
5. EASY STARTING DEVICE
6. AIR VENT VALVE
7. FUEL-INJECTION PUMP
8. FUEL-LIFT PUMP
9. "SHUT-OFF" CONTROL LEVER
10. THROTTLE CONTROL LEVER

Fig. B39 Exploded view of fuel-injection system

strictly adhered to, the fuel-injection pump requires no maintenance.

#### Adjustments

The fuel-injection pump is set and sealed on the initial fitting, and **must not** in any circumstances be altered.

##### Idling Stop

Run the engine at about quarter speed for a few minutes to warm up, then with the engine idling:—

Slacken the locknut on the idling stop screw, located on top of the governor casing, screw **in** to **increase** the idling speed or **out** to **decrease**, until an idling speed as low as possible is obtained without the danger of the engine stalling.

Tighten the locknut when the adjustment is completed.

Ensure that when connecting the linkage to the "shut-off" lever located on top of the governor casing, that the lever has a full range of movement when the control is operated.

##### Anti-stall Device (when fitted)

On certain pumps an anti-stall device has been incorporated, and is adjusted by means of the screw and locknut located at the drive end of the governor cover.

With the engine stationary, slacken the locknut and unscrew the adjusting screw until it is out of contact with the governor arm.

Start the engine and warm up to normal running temperature, then set the idling stop as previously instructed.

Carefully screw in the adjusting screw until a slight increase in speed is affected, then unscrew one third of a turn and lock.

Run the engine at maximum speed, then release the accelerator, if the engine stalls, screw in the adjusting screw **slightly**, alternatively, if the engine dies down or appears sluggish, unscrew the adjusting screw slightly, ensure that the locknut is tightened after each adjustment.

##### Throttle Control Lever

Ensure that when connecting the linkage to the throttle control lever, located on top of the governor casing, that the lever has a full range of movement when the control is operated. **It is most important that the pressure on the accelerator pedal is not transmitted to the maximum speed stop on the pump.**

##### Troubles

**To prevent dirt reaching the injectors, it is imperative that all the fuel filters should be cleaned regularly and thoroughly (see Section 31).**

When fuel pipes have been disconnected, make sure they are **cleaned thoroughly internally** with clean fuel oil before refitting them.

**If the engine misfires on one or more cylinders or lacks power, the fuel-injection pump should be checked as follows:—**

See that there is an adequate supply of fuel in the fuel supply tank.

**Air-lock existing in the pump chamber.** This must be cleared by disconnecting each injector delivery pipe union, at the injector end with the engine running, until fuel oil free from air bubbles leaks past the union threads, then re-tighten the unions. If necessary, prime the pump and vent the system as instructed in Section 28.

Check the main fuel filter(s) for cleanliness, and if necessary, renew the element(s), ensure that all pipe unions are tight and free from leakage.

Remove each injector in turn and reconnect to the fuel delivery pipe with the injector nozzle pointing away from the engine, and with the engine turning, ensure that the fuel passing through the injector is correctly sprayed and atomised. Replace any faulty injector.

If by a remote possibility, the presence of water is suspected in the system, the filter bowl should be drained daily until all trace of the water has disappeared. The source of ingress should be found and remedied.

#### To Remove

**NOTE.**—Dirt allowed into the fuel-injection pump or injectors will cause serious damage. Immediately pipes are disconnected from the fuel-injection pump, the ends of the pipes and the unions of the pump must be closed by suitable caps; if these are not available they may be covered with clean rag and bound with wire.

Close the fuel stop valve (when fitted).

Disconnect the linkage from the "shut-off" and throttle control levers.

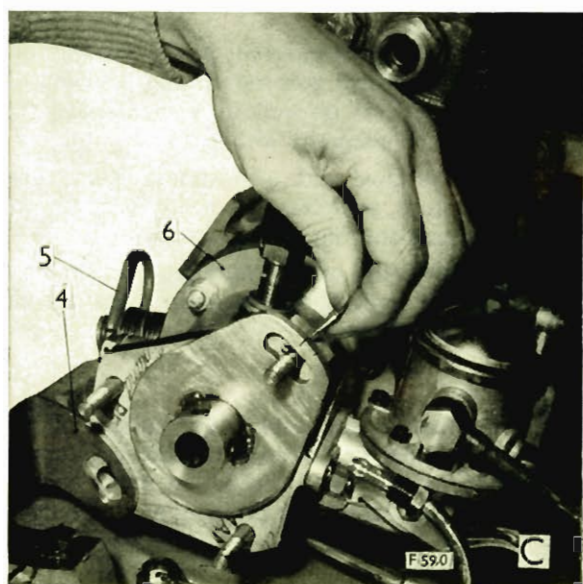
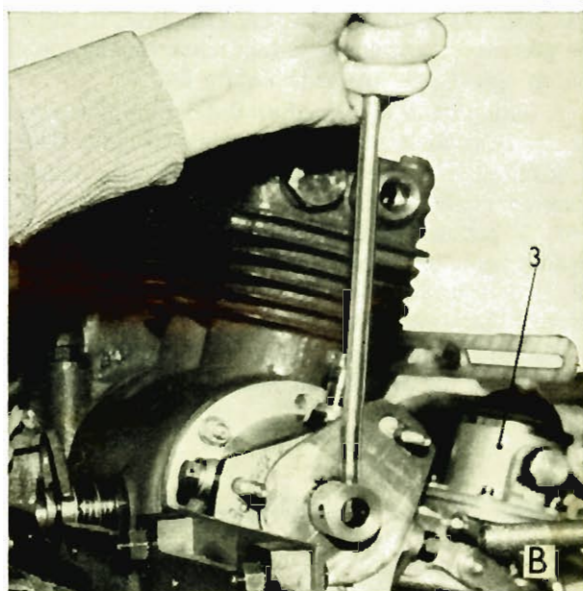
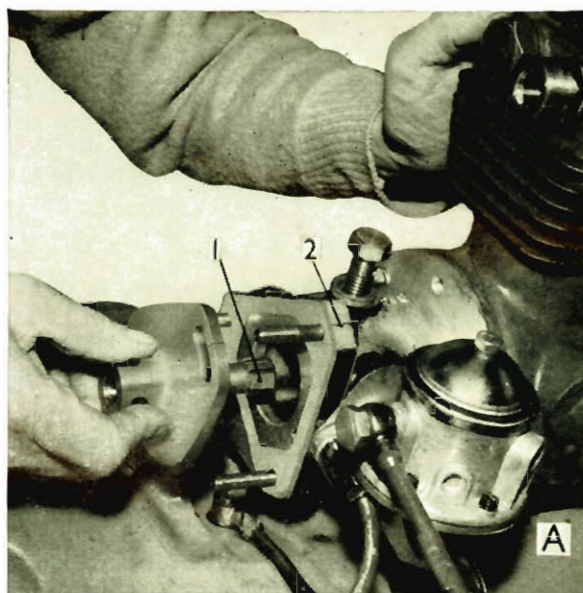
Remove from the fuel-injection pump, the fuel delivery pipes to the injectors and the fuel inlet and drain pipes.

Remove the nuts and washers securing the injection pump to the fuel-lift pump housing; then lift off the pump.

#### Key to Letters and Numbers:—

- A. METHOD OF FITTING TIMING TOOL
- B. TAKING UP THE BACKLASH
- C. METHOD OF SCRIBING TIMING MARK
- 1. QUILL SHAFT INSERTED IN TIMING TOOL
- 2. SCRIBED TIMING MARK
- 3. FUEL-LIFT PUMP
- 4. STEADY BRACKET
- 5. TEMPORARY CLAMP RETAINING COMPRESSOR DRAIN CONNECTION SPRING
- 6. FUEL-LIFT PUMP HOUSING

Fig. B40 Method of setting C.A.V. "Distributor" type fuel-injection pump timing



**To Fit**

Reverse the procedure of removal, ensuring that all parts are clean and in good condition, renew where necessary, tighten all pipe unions securely.

Check the fuel-injection pump timing as instructed under "To Time," prime and then vent the fuel system (*see Section 28*).

**To Time**

The correct fuel-injection pump timing in degrees B.T.D.C. is given in Section 1.

**It is most important that the following instructions are strictly adhered to and the correct fuel-injection pump timing is maintained.**

These instructions are applicable when a fuel-injection pump is initially fitted to the engine, or in the advent of a replacement drive housing, compressor, or an **unmarked** fuel-lift pump housing being fitted.

Alternatively, it is also a method of checking the timing when the complete fuel-injection pump drive has been dismantled, with one exception, it will not be necessary to scribe a timing mark on the fuel-lift pump housing as shown in Figure B40.

A timing mark is scribed on the mounting flange of the fuel-injection pump, as shown in Figure B40-A.

Rotate the engine flywheel in a clockwise direction (viewed from the front of the engine), until, with No. 1 piston on the compression stroke (No. 6 cylinder exhaust valve closing), the timing pointer on the flywheel housing is in line with the required correct mark on the flywheel.

Fit the fuel-injection pump drive, consisting of the compressor or whichever alternative unit is fitted,

complete with the fuel-lift pump housing, temporarily fitting the securing bolts.

Fit the timing tool listed in the Maintenance Equipment, into the drive coupling located inside the fuel-lift pump housing, as shown in Figure B40-A.

The slit in the timing tool should be approximately in the centre of the machined flange of the lift pump housing, which is to be marked.

Check that with the timing gears fully in mesh, the slit in the timing tool is within 4 mm. (0.16 in.), either way, of the centre of the machined flange ( $\frac{1}{2}$  mm. on the timing flange is equivalent to  $1^\circ$  on the engine flywheel). If it is not within this limit, withdraw the drive housing and re-mesh the gears in the required direction, to bring the slit to the correct position nearer the centre of the flange.

Securely tighten the drive housing bolts and insert a tommy bar in the timing tool as shown in Figure B40-B, then applying sufficient load to the tommy bar take up the backlash in the drive against the direction of rotation (as shown on the fuel-injection pump unit plate), it is **most important** to ensure that there is a clearance between the locating slot and the fuel-injection pump securing stud, when the backlash has been taken up.

Holding the tommy bar in the aforementioned position and using a sharp tool approximately 0.010 in. (0.254 mm.) thick in the slit of the timing tool as shown in Figure B40-C, scribe a line on the machined flange of the fuel-lift pump housing.

Fit the fuel-injection pump as instructed under "To Fit" and line up the timing mark on the pump flange with the scribed mark on the lift-pump housing.

**Section 27****FUEL-INJECTION PUMP—"IN-LINE" TYPE**

(*See Fig. B41*)

**Description**

The "Minimec" fuel-injection pump, consists of a combined cambox and governor casing, allowing for easy accessibility for inspection: a mechanical type governor is fitted integrally with the unit.

The pump is fitted with a maximum speed, idling and manual stops, an excess fuel device for use in cold weather for easy starting is also incorporated.

In addition to the oil overflow pipe, as shown in Figure B41, oil level, filler and drain plugs are also fitted in the pump casing.

**Lubrication**

Ensuring that the instructions for maintaining and servicing the main fuel filter(s) and the injectors are strictly adhered to, the fuel-injection pump requires no maintenance, other than draining and refilling, up

to the level plug with new lubricating oil at every engine oil change period. **Do not overfill.** (*For oil capacity see Part A*).

**Adjustments****Maximum Fuel and Speed Stops**

The maximum fuel delivery and speed stop screws are fitted on the governor housing. **These stops are set to the correct maximum speed and then sealed. As it is impossible to set accurately except on a calibrated test machine, they should not be altered.**

**Idling Stop**

Run the engine at about quarter speed for a few minutes to warm up, then with the engine idling:—

Slacken the locknut on the idling stop screw, located on the governor housing. Screw **in** to **increase** or **out** to **decrease** the idling speed until an idling

speed as low as possible is obtained without the danger of the engine stalling.

### Excess Fuel Device

The excess fuel device is incorporated in the governor housing to assist in starting the engine under very cold climatic conditions, the device allows fuel to be provided in excess of that required for normal running.

The excess fuel device, cannot and must not be operated under normal running conditions.

### Throttle Control Lever

Ensure that when connecting the linkage to the throttle control lever, located on the governor housing, that the lever has full range of movement when the control is operated; if necessary, adjust the lengths of the control rods between the lever and the accelerator pedal.

It is most important that the pressure on the accelerator pedal is not transmitted to the maximum speed stop on the pump.

### Troubles

To prevent dirt reaching the injectors, it is imperative that all the fuel filters should be cleaned regularly and thoroughly (see Section 31).

When fuel pipes have been disconnected, make sure they are **cleaned thoroughly internally** with clean fuel oil before refitting them.

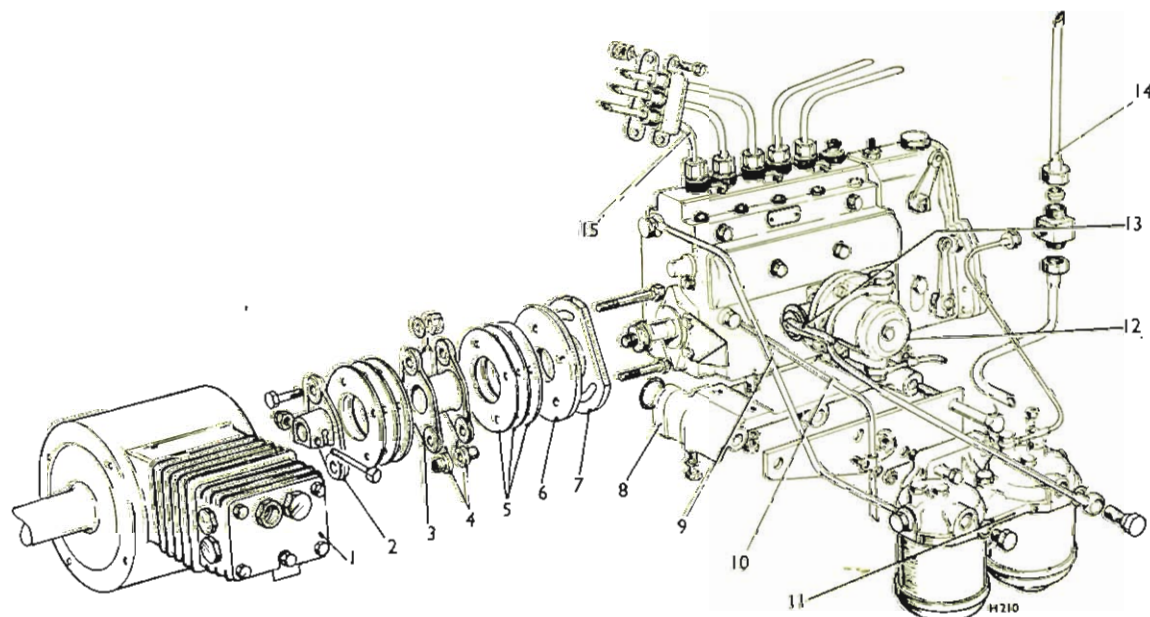
**If the engine misfires on one or more cylinders or lacks power, the fuel-injection pump should be checked as follows:—**

See that there is an adequate supply of fuel in the fuel supply tank.

**Air-lock existing in the pump chamber.** This must be cleared by opening the air vent, with the engine stopped and operating the priming lever of the fuel-lift pump (see Figs. B46 and B47) until fuel, free from air bubbles, flows from the vent.

**Check the discharge from each injection pump plunger** by disconnecting each of the fuel delivery pipe unions at the injector end in turn, while the engine is idling and momentarily depressing the accelerator. The fuel should be delivered in well defined spurts, regularly, and in uniform quantity. Should this test reveal that one or more plungers are either failing to deliver fuel, or doing so irregularly, this may be due to one of the following causes:—

**Persistent dribble from the delivery valve holder** caused by a sticking delivery valve. This may be due to dirt admitted by careless handling of the pump, or



### Key to Numbers:—

- |                   |                             |                         |
|-------------------|-----------------------------|-------------------------|
| 1. COMPRESSOR     | 6. ADJUSTING PLATE          | 11. TWIN FUEL FILTERS   |
| 2. DRIVE COUPLING | 7. DRIVE COUPLING           | 12. FUEL-LIFT PUMP      |
| 3. DRIVE SHAFT    | 8. SUPPORT BRACKET          | 13. PRIMING LEVER       |
| 4. SLEEVE         | 9. FUEL INLET PIPE          | 14. GALLERY RETURN PIPE |
| 5. DRIVING PLATE  | 10. CONSTANT OIL LEVEL PIPE | 15. FUEL DELIVERY PIPE  |

Fig. B41 Exploded view of typical "In-line" fuel-injection type pump drive

the fuel pipe between the main filter and pump during removal from the engine.

Alternatively, a filter element may be damaged or omitted, allowing dirt to pass to the injection pump.

To determine the cause, disconnect all the fuel delivery pipe unions from the injectors while the engine is stopped and operate the priming lever of the fuel-lift pump (*see Figs. B46 and B47*). Turn the engine approximately one revolution and repeat. There should be no flow of fuel from any of the unions **whilst the engine is stopped**. If flow of fuel is apparent, remove the delivery valve as follows:—

It is necessary to use a suitable serrated socket spanner when removing the delivery valve holder, and when refitting the valve holder it should be tightened to the correct torque loading as given in Section 33.

Unscrew the fuel delivery pipe union nut.

Unscrew the delivery valve holder and lift out the delivery valve assembly.

Inspect the sealing washer under the delivery valve holder, the resilient sealing rings, and see that they are not split or damaged.

Wash the delivery valve parts and the seating in clean fuel oil, then re-assemble on to the injection pump, checking to see that the delivery valve is free in its guide.

Tighten the delivery valve holder (*for torque spanner loading see Section 33*), then connect the fuel delivery pipe. When all delivery valves have been checked in this manner, with the engine stopped, vent the system by opening the air vent (*see Fig. B41 and Section 28*). Operate the lever of the fuel-lift pump until fuel, free from air bubbles, flows from the air vent.

**A delivery valve may be seized or a spring broken**, in which case replacement parts should be fitted.

### To Remove

**NOTE:—Dirt allowed into the fuel-injection pump or injectors will cause serious damage. Immediately pipes are disconnected from the fuel-injection pump, the ends of the pipes and unions of the pump must be closed by suitable caps; if these are not available they may be covered with clean rag and bound with wire.**

Close the stop valve (when fitted).

Disconnect from the fuel-injection pump, the fuel delivery pipes to the injectors, the fuel inlet and oil overflow pipes.

Disconnect from the fuel-lift pump, the fuel inlet and outlet pipes and place corks or suitable stoppers in their ends to prevent the loss of any fuel.

Remove the fork-end pin from the throttle control and manual stop levers.

Remove the bolts passing through the coupling at the compressor end.

Remove the locking wire and unscrew the setscrews which secure the fuel-injection pump support bracket to the engine casing; retain the rubber rings fitted between the bracket and the engine casing.

Remove the pump complete with the bracket and drive shaft, note the positions of the coupling alignment sleeves and drive plates.

Separate the injection pump from the support bracket; if necessary, the coupling can be removed from the pump as follows:—

Remove the coupling securing nut and with a suitable withdrawal tool, detach the coupling from the pump.

### To Fit

Reverse the procedure of removal, noting the following points:—

Examine the rubber rings fitted between the support bracket and the engine casing and renew if necessary.

Ensure that the coupling alignment sleeves are fitted correctly.

Check the timing as instructed under "To Time", and then vent the fuel system as instructed in Section 28.

### To Time

The correct fuel-injection pump timing is given in degrees B.T.D.C. in Section 1.

Check the timing by rotating the engine flywheel in a **clockwise** direction (viewed from the front of the engine), with No. 1 piston on the compression stroke No. 6 cylinder exhaust valve closing and the timing pointer on the flywheel housing in line with the correct mark on the flywheel.

The mark on the injection pump driving flange should then be in line with the pointer on the pump body.

Any slight variation can be corrected by slackening the two setbolts on the drive coupling and lining up the markings by rotating the pump coupling and tightening the setbolts.

### Fuel Spill Cut-off Point

This term refers to the instant when the flow of fuel through the fuel spill port is cut off by the pump plunger on its upward stroke. For all practical purposes it corresponds to the commencement of fuel-injection.

The following procedure is for determining the point of spill cut-off:—

Remove the injectors (*see Section 29*).

Unscrew the fuel delivery pipe union nut from No. 1 delivery valve holder.

Remove the locking device.

Unscrew No. 1 delivery valve holder and lift out the volume reducer, spring and delivery valve, putting them in a clean and safe place.

Fit the delivery valve holder and connect the injection pump fuel inlet pipe to a supply of fuel under a small head.

Move the fuel-injection pump control lever to the full power position, then turn the **pump** slowly in a **clockwise** direction looking at the flywheel end of the pump, or if on the engine, turn the **engine** slowly in a **clockwise** direction looking at the front.

Fuel will flow freely from No. 1 delivery valve holder for a large part of a revolution of the **pump** then drop to a barely perceptible amount as determined by wiping the fuel out of the depression in the top of the delivery valve holder and watching for it to creep slowly back again.

**The instant when the flow of fuel ceases is the point of fuel spill cut-off.**

At the point of fuel spill cut-off for No. 1 cylinder the pointer on the injection pump should be opposite the correct mark on the pump flywheel at the end of the compression stroke and the timing mark on the engine flywheel should be in line with the pointer on the flywheel housing.

**If a check proves that the injection pump is retarded**, i.e. spill cut-off occurs between the correct mark and the "T.D.C.I" mark on the engine flywheel turn the engine flywheel **back** to the correct mark. Slacken the

two setscrews on the slotted portion of the drive coupling and turn the pump flywheel in a **clockwise** direction (looking at the flywheel end of the pump) until fuel spill cut-off is again reached. Only a very small movement will be necessary. Finally, tighten the two setscrews on the slotted portion of the coupling.

**Should a check prove that the injection pump is too far advanced**, i.e. spill cut-off occurs before the correct mark, turn the engine flywheel **on** to the correct mark, and loosen the two setscrews on the slotted portion of the coupling.

Turn the pump flywheel in an **anti-clockwise** direction until fuel flows from No. 1 delivery valve holder, then turn it in a **clockwise** direction until fuel spill cut-off occurs. Finally, tighten the two setscrews on the slotted portion of the coupling.

Wash the delivery valve components in clean fuel oil, re-assemble and tighten the delivery valve holder to the correct torque (*for torque loadings see Section 33*), connect the delivery pipe to No. 1 delivery valve holder (*for torque spanner loadings see Section 33*). Examine all unions for fuel leaks, correct if necessary, and vent the system (*see Section 28*).

Start the engine, and when warm adjust the idling stop if necessary, to give steady idling.

## Section 28

## FUEL SYSTEM—TO VENT

**AFTER REMOVAL OF THE FUEL TANK OR ANY PART OF THE FUEL SYSTEM**, e.g., INJECTORS, PIPES, FILTERS, PUMP, ETC., THE SYSTEM MUST BE VENTED TO EXPEL THE AIR.

IT IS ADVISABLE TO VENT THE FUEL-INJECTION PUMP PERIODICALLY WHILE THE ENGINE IS RUNNING AND THUS MAKE SURE THAT THE SYSTEM IS KEPT FREE OF AIR AT ALL TIMES.

Check that the main fuel filter(s) is/are full of fuel oil.

**On engines fitted with a "Distributor" type fuel-injection pump proceed as follows:—**

Slacken the air vent valve on one of the two hydraulic head locking screws on the fuel-injection pump casing (*see Fig. B39*).

When fitted, unscrew by 2 or 3 turns the vent plug(s) on the top of the main fuel filter(s) cover.

Operate the priming lever of the fuel lift pump and when fuel, free from air bubbles, issues from each venting point, then tighten the filter cover vent plug(s) and the head locking screw vent valve in that order.

Slacken the union nut of the fuel inlet pipe at the fuel-injection pump end, operate the priming lever of the fuel-lift pump, until fuel oil free from air bubbles issues from around the threads of the union, then tighten the nut.

Slacken the unions at the injector ends of two of the fuel delivery pipes.

Set the accelerator at the fully open position and ensure that the engine "Stop" control is in the "run" position; rotate the engine until fuel oil, free from air bubbles, flows from both delivery pipes, and finally tighten the unions.

### Priming Procedure after Fitting a New Filter Element

After fitting the new filter element (*see Section 31*), remove the vent plug(s) (when fitted) from the top of the filter cover, slacken the union nut at the filter end of the return pipe (filter to supply tank), operate the priming lever of the fuel-lift pump, until fuel oil, free from air bubbles, issues from the filter cover vent.

Fit and tighten the vent plug(s), continue to operate the hand priming lever until fuel oil, free from air bubbles, issues from around the threads of the return pipe union, then tighten the union nut.

Slacken the union nut at the filter end of the feed pipe to the fuel-injection pump, and adopt the same procedure of priming until free from air bubbles, finally tighten the union nut.

The filter(s) is/are now ready for further service.

**On engines fitted with an "In-line" type fuel-injection pump, proceed as follows:—**

Unscrew the vent plug(s) on the main filter(s) **one turn** (see Fig. B49) and operate the hand priming lever of the fuel-lift pump (see Fig. B47) until fuel free from air bubbles appears around the air release vent; then tighten the plug(s). Open the air vent on the fuel-injection pump and again operate the hand priming lever until fuel free from air bubbles flows from the vent.

Start the engine and allow it to run at idling speed with the air vent open until all trace of air bubbles

in the fuel has disappeared, then close the vent **whilst the engine is still running.**

If the system is free of air, the engine, when hot, should accelerate rapidly and without hesitation. If this does not occur, then with the engine idling, slacken off each fuel delivery pipe union at the injector end in turn, just sufficiently to allow fuel to seep out, and watch for air bubbles between the pipe and the union nut. Should bubbles be detected, leave the nut slack until air-free fuel appears, then tighten down. Treat each union in turn in this manner and finally open the air vent cock for a few moments.

It is a wise precaution to do this even though the above acceleration test does indicate that all air has been removed.

**NOTE.**—If union nuts are slackened off more than just enough to allow the fuel to seep out the force with which the fuel issues from the pipe will produce a froth even if no air is present in the pipe.

## Section 29

## INJECTORS

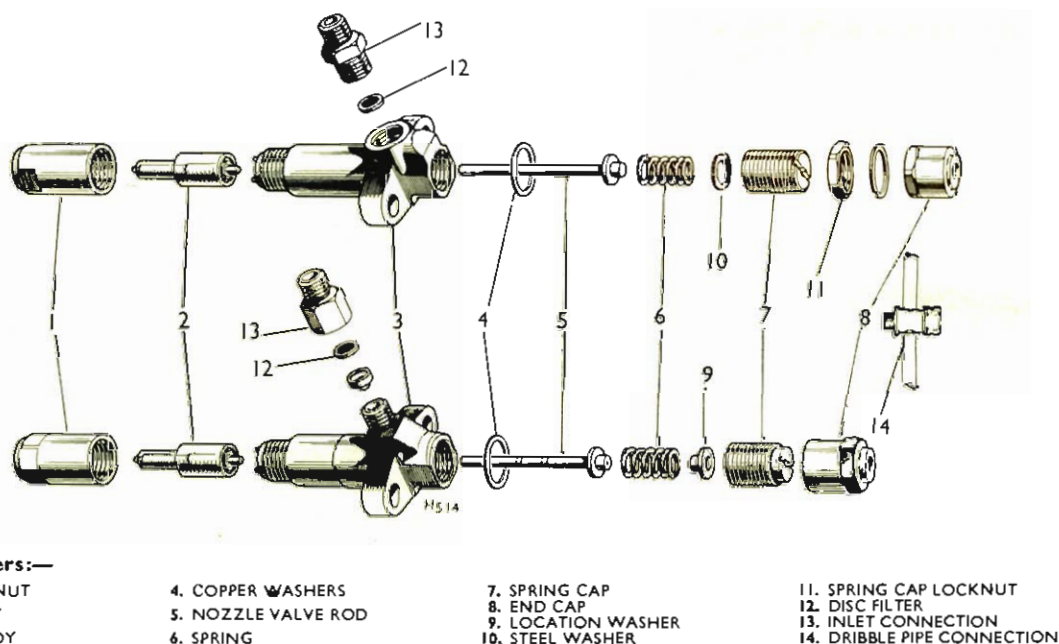


Fig B42 Exploded view of injector — alternative types

### Description

The injectors fitted to the AEC 471 cu. in. or 505 cu. in. capacity engines are of the multi-hole type, and are not necessarily interchangeable with those used on any other type or make of engine.

The injector is, in effect, a simple spring-loaded valve adjusted to open automatically as soon as the

fuel oil reaches a pre-determined pressure, the quantity of fuel oil delivered to the injector being controlled by the fuel-injection pump. The slight leakage of fuel which lubricates the nozzle valve and accumulates within the spring chamber is returned through the dribble pipes and gallery pipe, which is designed to connect up to the fuel supply tank.

A disc filter is fitted into the injector body.

### Faults—To Locate

Any troubles experienced with injectors will probably be accompanied by one or more of the following:—

Heavy smoke from the exhaust when the engine is hot and pulling on load.

Pronounced knocking in the affected cylinder.

Complete or intermittent misfiring.

Loss of power.

Very often it is possible to locate an injector which is not working correctly, by slackening off the fuel delivery pipe union nut two or three turns at the injector end and allowing the fuel to leak past the threads, whilst the engine is running slowly. This prevents fuel passing through the nozzle into the cylinder. If no change is detected in the performance of the engine or sound of the exhaust, it is reasonable to assume that the injector is faulty.

Fit a spare injector (*see under "To Fit"*) and vent the fuel system (*see Section 28*), Blank off the inlet and dribble unions, fit a dust cap to the nozzle of the faulty injector and return it for servicing.

### To Remove

Disconnect the fuel delivery and dribble pipes from the injector and slacken the fuel delivery pipe union at the fuel-injection pump end, it may be found necessary to remove more than one dribble pipe connection this will allow movement of the gallery pipe, to facilitate easy removal of the injector to be serviced.

Remove the two nuts from the studs securing the injector to the cylinder head.

Lift the injector out, taking care not to damage the threads of the studs.

**If injectors are not refitted immediately, blank off the inlet and dribble unions with dust washers and corks, or, if these are not available, use clean rag bound with wire to prevent ingress of dirt.**

A rubber sealing washer, initially fitted in the top of the injector sleeve, has been introduced to obviate the possibility of moisture entering the sleeve during storage. When these washers become worn it is not necessary to renew them and they can be dispensed with.

### To Service the Injector

Injectors should be removed from the engine and dismantled on a bench used specifically for the purpose and where scrupulous cleanliness is observed.

Faulty injection may be caused by any of the following defects:—

- (i) External carbon on the nozzle.
- (ii) Choked nozzle holes.
- (iii) Dirt and carbon under the seat of the nozzle valve and in the nozzle tip.
- (iv) Nozzle valve sticking in the body.

(v) A cracked nozzle.

(vi) A broken spring.

(vii) Incorrect spring adjustment.

(viii) Air and water in any part of the fuel system due to defective filters.

After removing the suspected injector and **before opening it up**, proceed as follows:—

Clean any carbon from the exterior of the nozzle with the brass wire brush shown in Figure B43 and listed in the Maintenance Equipment, then reconnect it to its fuel delivery pipe, start the engine and note the spray from the nozzle.

Alternatively, if available, use a hand testing pump (*see Fig. B44*).

**When the hand testing pump is used for testing a nozzle for dribble, or for observing the nature of the sprays, the pressure gauge must be shut off by means of the stop valve.**

When working correctly, the nozzle should give four sprays which should appear alike and of the same length free from streaks or jets of undivided fuel, and the nozzle tip should remain dry after fuel cut-off.

### To Test the Injector:—

Fit the injector to the hand testing pump.

Give about six strokes of the hand lever to expel all air from the nozzle.

Operate the hand lever at the rate of about 60 strokes per minute and observe the spray as previously described.

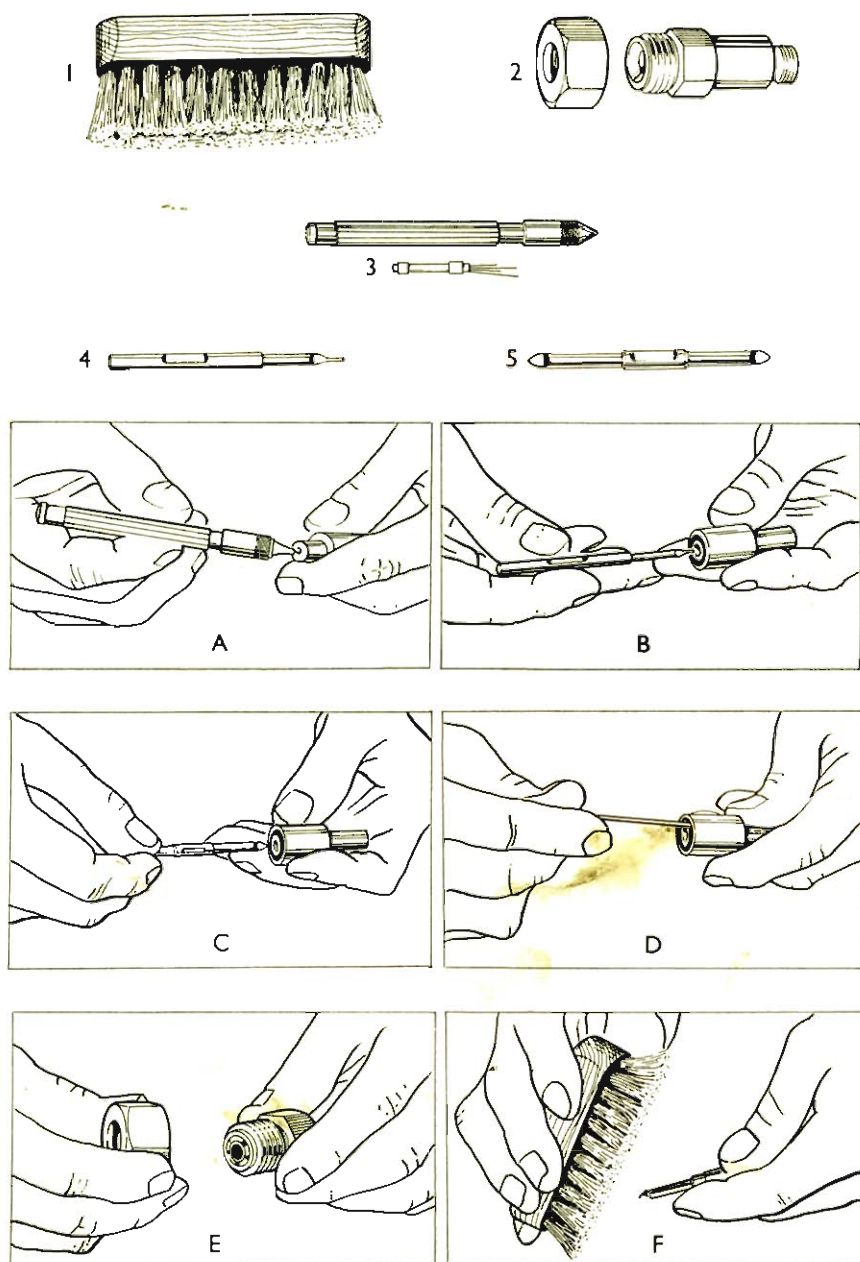
If all four sprays are satisfactory, but dribble occurs after cut-off it may be due either to defect number (iii) or (v), or occasionally number (iv).

Wipe the nozzle dry and repeat the test, watching carefully to see the point from which fuel leakage originates. If from the nozzle holes, number (iii) or (iv) is the cause; if from between the nozzle and the nozzle cap nut, or elsewhere, the nozzle cap nut may be loose or dirt may be trapped between the joint faces of the body and nozzle; a cracked nozzle may also be responsible.

Jets without spray indicate that the injector valve spring cap has slackened off, lowering the spring tension; that the nozzle valve is sticking, or that there is a broken spring or foreign matter under the valve seat.

If all the holes are clear, the sprays even, and the nozzle does not show signs of dribble, turn on the pressure gauge on the hand-testing pump and check that the spraying pressure reads **the correct atmospheres** (*see Section 1*).

If the pressure is incorrect, unscrew the end cap on top of the injector (*see Fig. B42*), slacken the lock-



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**Key to Letters and Numbers:—**

- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| A. PRICKING OUT NOZZLE HOLES      | 1. WIRE BRUSH                     |
| B. CLEANING NOZZLE TIP            | 2. ADAPTOR—NOZZLE FLUSHING        |
| C. CLEANING NOZZLE SEAT           | 3. NEEDLE HOLDER AND WIRE NEEDLES |
| D. CLEANING NOZZLE FUEL PASSAGES  | 4. NOZZLE TIP SCRAPER             |
| E. NOZZLE IN ADAPTOR FOR FLUSHING | 5. NOZZLE SEAT SCRAPER            |
| F. CLEANING NOZZLE VALVE          |                                   |

**Fig. B43 Method of cleaning injectors**

nut (when fitted) on the spring cap, and screw in the cap to **increase** the pressure, or **out** to **decrease** the pressure.

When the opening pressure is correct, hold the pressure at 100 atmospheres for one minute. The nozzle tip should not become wet or tend to dribble during this period; if satisfactory, fit the end cap.

The injector then is ready for fitting to the engine.

**Note.**—When testing nozzles, care must be taken to prevent the hand from contacting the spray as the working pressure will cause fuel to penetrate the skin.

### To Dismantle

Refer to "Note" in the instructions given under "To Clean and Assemble."

Remove the end cap, slacken off the locknut (when fitted) and the spring cap.

Hold the injector body with the nozzle pointing upwards, either in a vice by the flats above the flange, or with a tool similar to that shown in Figure B45. Unscrew the nozzle cap nut and lift away the nozzle body and nozzle valve.

Reverse the injector body (if this is in the vice, grip the flange) and unscrew and remove the spring cap, location or steel washer, spring and nozzle valve rod.

Unscrew the inlet connection and remove the disc filter.

Examine the spring; if broken or rusty it should be renewed.

Examine the nozzle and valve; these parts must be handled with care and every precaution taken to avoid damage.

**It is important that the nozzle valve must always be mated to its original body. Accordingly, injectors should only be dismantled one at a time.**

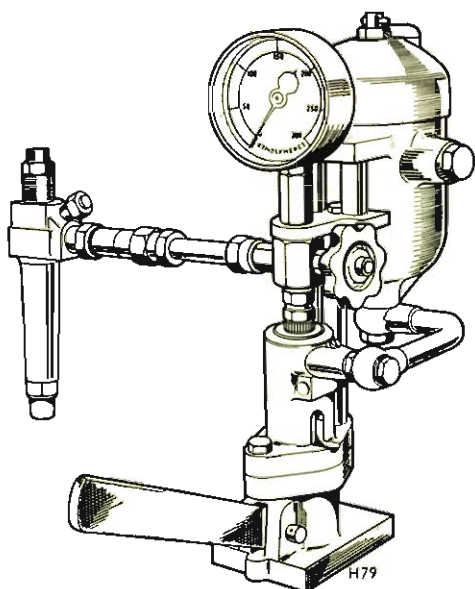
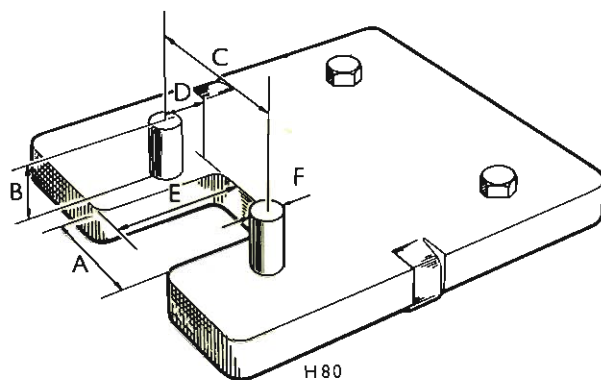


Fig. B44 Typical hand-testing pump for injectors



### Key to Letters:—

A. 34 mm.	D. 15 mm.
B. 15.8 mm.	E. 38 mm.
C. 50 mm.	F. 9.5 mm. (Dia.)

Fig. B45 Injector holder

Withdraw the valve from the nozzle. The valve must be a smooth sliding fit in the nozzle body and the bearing surface of the valve must be smooth and free from scores, scratches or discoloration. Clean in accordance with the instructions given under "To Clean and Assemble." If the bearing surface of the valve is scored or the tip shows a blue discoloration, **both nozzle body and valve should be renewed.**

**Note.**—Replacement nozzles and valves must be fitted in pairs and not as single parts.

### To Clean and Assemble (See Fig. B43).

CLEANLINESS IS ESSENTIAL AND AMPLE SUPPLIES OF CLEAN PARAFFIN OR FUEL OIL MUST BE AVAILABLE. Special tools are listed in the Maintenance Equipment to enable the servicing of a nozzle to be carried out quickly and safely. ON NO ACCOUNT MUST ANY TOOLS OTHER THAN THOSE DESCRIBED HERE BE USED OR SERIOUS DAMAGE TO NOZZLES WILL RESULT.

ABRASIVE OR METAL POLISH MUST NOT BE USED ON THE NOZZLES OR VALVES.

A special hand testing pump (see Fig. B44) to facilitate the testing and setting of nozzles should be available, together with a cleaning outfit as shown in Figure B43, which is listed in the Maintenance Equipment.

**Note.**—In the case of injectors which are in a very dirty condition externally, blank off the fuel connection and dribble unions, then wash thoroughly in paraffin or clean fuel oil.

Brush the nozzle externally with the brass wire brush, then proceed to dismantle in accordance with the instructions given under "To Dismantle."

Wash the injector body and wash out the fuel passages with clean paraffin or fuel oil; clean and wash the cap nut and place the injector body and cap nut to drain.

Remove the nozzle valve and complete the external cleaning of the **nozzle body** with the brass wire brush, then wash externally.

Prick out the nozzle holes (see Fig. 43-A) with one of the wire needles holding it by means of the tool holder and dislodge any dirt from the **nozzle tip** (see Fig. B43-B) with the brass tool.

**Note.**—

**Care should be taken to see that the correct size of "D" needle is used when cleaning choked holes in order to avoid damage to the nozzle (see Section 1 for diameter of holes).**

Clean the nozzle valve seat (see Fig. B43-C) with the brass tool, then clean out the fuel passages in the **nozzle body** with a piece of brass wire (see Fig. B43-D).

Place the **nozzle body** (see B43-E) in the adaptor and nut, and wash it out **backwards** with clean fuel oil under pressure from the hand testing pump. The nozzle joint face should be arranged to point downwards when in this adaptor, in order to avoid dirt or carbon being pocketed in the nozzle recesses.

Brush the seat and stem of the nozzle valve (see Fig. B43-F) with the brass wire brush, wash off in clean paraffin and insert in the nozzle body while this is still being washed (see above). This ensures that the needle seat is clean when entered into the nozzle body and that the washing back process extends to the three fuel passages in the nozzle body.

Wash off the joint face of the **injector body**, remove the nozzle body and valve from the washing adaptor and mount it on the injector body taking care to **engage the dowels** (see Fig. B42); screw on the cap nut and tighten. No unnecessary force should be used when tightening the cap nut; only an ordinary pull should be exerted on the spanner.

Wash thoroughly and refit the nozzle valve rod, spring, spring washer, spring cap and locknut (when fitted).

Wash thoroughly the disc filter in clean fuel oil, and place it in the injector body.

Reset the opening pressure to the correct atmospheres and test the injector (see under "To Test the Injector") by operating the hand testing pump at the rate of about 30 to 40 strokes per minute.

Hold the pressure at 100 atmospheres for one minute. The nozzle tip should not become wet or tend to dribble during this period.

Fit the copper washer and end cap.

Finally, blank off the fuel connection with a clean nut and blanking disc, plug the dribble pipe connection and place a dust cover over the nozzle.

If the injector is not fitted immediately to the engine it should be wrapped in a clean rag to prevent damage and exclude dirt.

### To Fit

Place the injector in the copper sleeve in the cylinder head. **Do not fit a gasket or washer as the sleeve forms the only gasket that is required.** The injector should drop into place without being forced.

Place the nuts on the studs securing the injector to the cylinder head, **and tighten them evenly, half-a-turn at a time to the specified torque**, to prevent distortion of the injector (for torque spanner loadings see Section 33).

If the injector fouls the hexagon boss on the studs when tightening down, **due to its seating lower in the copper sheath, the hexagon boss must be relieved until the correct seating is obtained.**

Connect the delivery pipe from the pump to the injector and tighten the union nut at the fuel-injection pump end.

**Note.**—**Do not overtighten** the delivery pipe union nuts, they should be tightened finger tight and then secured by  $\frac{1}{4}$  to  $\frac{1}{2}$  a turn, which will give the approximate torque loading as shown in Section 33.

Connect the dribble pipe to the injector.

Examine all fuel pipe connections for leaks, correct as necessary, and vent the system as described in Section 28).

## Section 30

## FUEL-LIFT PUMP

(See Figs. B46 and B47)

### AC "U" Type Pump (see Fig. B46)

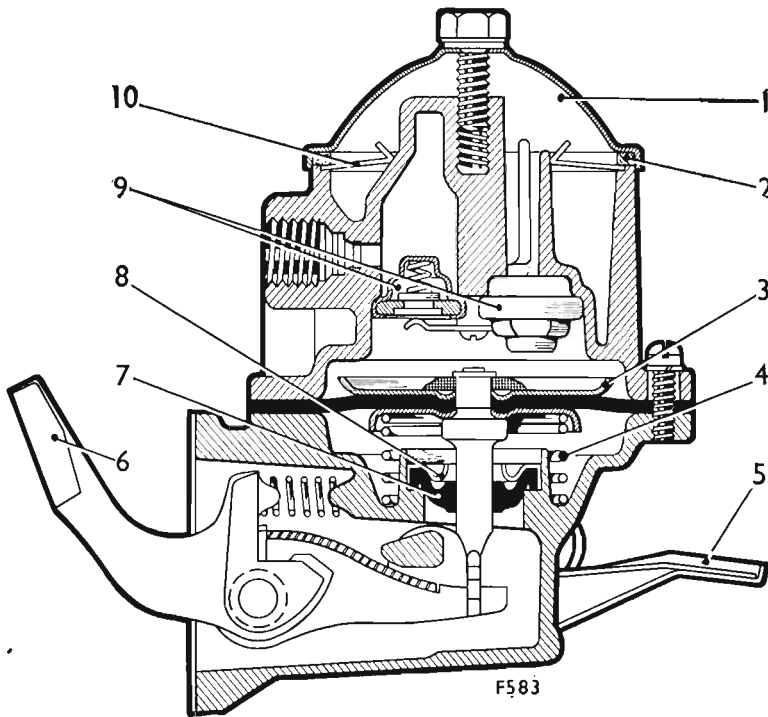
#### Description

The fuel-lift pump which is flange mounted on the lift pump housing, is driven by an eccentric on the drive coupling.

The lift pump draws fuel from the supply tank and forces it at constant pressure through the main fuel filter(s) to the fuel-injection pump.

The lift-pump is of the diaphragm type and the fuel is lifted by the action of the diaphragm, clamped between the outer flanges of the two main bodies of the lift pump.

The lower body contains the rocker arm, diaphragm and priming lever assemblies, whilst incorporated in the upper body are the inlet and outlet valve assemblies, which are identical in construction and are renewable and interchangeable; a filter gauze secured



**Key to Numbers:—**

1. DOMED COVER
2. GASKET
3. DIAPHRAGM ASSEMBLY
4. DIAPHRAGM RETURN SPRING
5. PRIMING LEVER
6. ROCKER ARM
7. SEAL
8. SEAL RETAINER
9. VALVE ASSEMBLIES
10. FILTER GAUZE

**Fig. B46 Sectional view of AC "U" type fuel-lift pump**

by a domed metal cover is also located in the upper body.

Finally, the fuel line can be primed by moving the hand priming lever in a pumping action, until the operator feels no resistance to the movement of the lever.

**To Remove**

Disconnect the inlet and outlet fuel pipe connections, unscrew the securing nuts and remove the lift pump from its mounting.

**To Dismantle**

Before commencing to dismantle, clean the exterior of the pump and scribe a line across the lower and upper body flanges, to ensure correct location on assembly.

Remove the securing screw and detach the domed cover from the upper body, lift out the gasket and filter gauze.

Remove the screws and washers securing the lower and upper bodies together and separate the bodies.

From the upper body, remove the screws securing the retainer plate and remove the plate, valve assemblies and gasket, note the position of the valves to ensure they are fitted correctly on assembly.

Remove the diaphragm assembly from the lower body by turning the assembly through an angle of 90° in order to free the pull rod from the rocker arm link, then lift out the diaphragm return spring, oil seal washer and retainer.

The diaphragm and pull rod are a permanent assembly and no attempt should be made to dismantle these parts.

It should not be necessary to remove the rocker arm pin or associated parts, providing that the pin is held firmly in the lower body and no undue wear has taken place; if wear is apparent, proceed as follows:—

The rocker arm assembly is retained by two retainers fitted in slots in the casting of the mounting face, the retainers in turn being secured by centre punch indentations at each end of the retaining pins.

Secure the rocker arm firmly in a suitably protected vice, with a sufficient gap between each side of the casting and the vice, to allow the insertion of two flat bars approximately 12 in. (305 mm.) long; with the bars in position lever the body away from the rocker arm and pin. Remove the spacing washers and link from the pin and retain the return spring.

It is most important that **flat** bars are used for this operation, to avoid damage to the machined mounting face.

The priming lever assembly should only be removed if found defective; if it is necessary, file off the riveted head of the pivot pin and tap the pin through the body.

**To Assemble**

Reverse the procedure given under "To Dismantle," noting the following points:—

Thoroughly clean all parts in clean paraffin, taking special care with the valve assemblies.

Oil seals and gaskets should be discarded and replaced with new.

Check all remaining parts for wear or distortion, if either the diaphragm or engine mounting flanges are distorted, they should be lapped to restore their even surface; renew the bodies if the distortion is excessive.

Slight wear is permissible on the face of the rocker arm pad, but should not exceed a depth of 0.010 in. (0.254 mm.).

The diaphragm, priming lever and valve assemblies are replaceable as complete units.

If the priming lever assembly has been removed, fit a new assembly by inserting the pivot pin through the lower body together with the priming lever, then with the return spring in position, rivet over the exposed end of the pin.

If the rocker arm assembly has been dismantled, proceed as follows:—

Fit the rocker arm, link and spacing washers to a **new** pivot pin, insert the return spring into the lower body followed by the rocker arm assembly, ensuring that the return spring is engaging correctly between the locating “pips” on the casting and the rocker arm.

Tap two **new** retainers into the slots in the body, and whilst holding the retainers securely against the rocker arm, pin punch over the end of the slots with an  $\frac{1}{8}$  in. (3.2 mm.) punch to prevent the retainers working loose.

Fit a **new** oil seal washer and retainer into the lower body and place the diaphragm return spring in position over the oil seal retaining washer.

With the locating tab on the diaphragm at the twelve o'clock position and the pull rod pointing downwards, place the diaphragm assembly over the return spring and press down the diaphragm against the spring, at the same time turning the assembly to the left, so that the slot on the pull rod will engage the fork in the rocker arm link: finally turning the assembly a complete quarter of a turn to the left, which will place the pull rod in its correct working position in the link.

This will also align the holes in the diaphragm with those on the pump body flange and the locating tab will now be in the “nine o'clock” position.

Fit a **new** valve gasket in the upper body and insert the valve assemblies in the same positions from which they were removed on dismantling, i.e., the inlet valve spring facing outwards and the outlet valve spring inside the port.

Fit the valve retainer plate and securely tighten the screws.

Insert the filter gauze in the top of the upper body and fit the domed cover, ensuring that the fibre

washer is fitted beneath the head of the securing screw.

Push the rocker arm towards the pump body until the diaphragm is level with the body flange, place the upper body on the lower body, aligning the marks previously made on dismantling, fit the securing screws and tighten only until heads of the screws just engage the washers.

Release the rocker arm and push it away from the pump, to allow the diaphragm to be held at the top of its stroke, and whilst so held, tighten the securing screws diagonally and securely.

When finally assembled, the edges of the diaphragm should be approximately flush with the clamping flanges of the upper and lower bodies, any appreciable protrusion of the diaphragm will indicate incorrect fitting; special care must be taken in maintaining the downward pressure on the rocker arm, when the securing screws are finally tightened.

If necessary, the lift pump can be tested in position by disconnecting the fuel outlet pipe at the opposing end to the lift pump, rotate the engine by hand, when there should be a well defined spurt of fuel oil at every working stroke of the lift pump.

#### AC “VP” Type Pump (see Fig. B47)

##### Description

The lift pump is of the diaphragm type, the fuel being lifted by the action of the diaphragm clamped between the flanges of the lower body and the piston guide.

The lower body contains the rocker and diaphragm assemblies, whilst incorporated in the upper body are the inlet and outlet valve assemblies which are identical in construction and are renewable and interchangeable; a pulsator diaphragm secured by a metal cover is also located in the upper body.

The priming lever assembly, is attached to the lower body.

##### To Remove

Disconnect the inlet and outlet fuel pipe connections from the fuel-lift pump, then remove the pump from its mounting on the fuel-injection pump.

##### To Dismantle

Clean the exterior of the unit, and to ensure the correct positions when assembling, mark the flanges of the upper and lower bodies in relation to each other.

Remove the securing screws and separate the upper and lower bodies.

Remove the cover securing screw and detach the cover and the pulsator diaphragm.

The inlet and outlet valve assemblies are removed by levering them carefully from their seatings; note their position for assembling.

Remove the diaphragm assembly by disconnecting the pull rod from the rocker arm link.

Drive out the rocker arm pin and remove the link and arm.

Tap out the retaining pin and remove the priming lever assembly.

### To Assemble

Thoroughly clean all parts in clean paraffin, taking special care with the valve assemblies.

Seals and gaskets should be discarded and replaced with new.

Check all remaining parts for wear and distortion. If either the diaphragm or mounting flanges are distorted, they should be lapped to restore their even surface; renew the bodies if the distortion is excessive.

The diaphragm, and valve assemblies are replaceable as complete units.

Fit **new** valve gaskets in the upper body and insert the valve assemblies in the same position from which they were removed for dismantling, i.e. the inlet valve spring must protrude into the pump chamber and the outlet valve in the reverse position, secure the valves in position by centre punching in four opposing places.

Place the pulsator diaphragm in the cover and fit the assembly to the upper body, tightening the cover with the securing setscrew.

Assemble the link, rocker arm and spring into the lower body, insert the arm pin through the hole in the body engaging the link and rocker arm, then tap in until flush with the body ensuring that the spring is located correctly; secure the pin by centre punching in three opposing places.

The fitting of the rocker arm can be simplified by first inserting a 0.240 in. (6.1 mm.) diameter rod through the pin hole in the side of the body to engage the arm and link, and then inserting the pin in from the opposing side; remove the temporary rod when the pin is located in the correct position.

Place the diaphragm in position in the lower body, fit the diaphragm assembly over the spring with the pull rod **facing downwards**, and centre the upper end of the spring in the lower protector disc.

Press down on the diaphragm, ensuring that the downward tag on the lower protector disc is on the priming lever side of the body; the tag is required to be in the hole in the body, ready for the fitment of the priming lever.

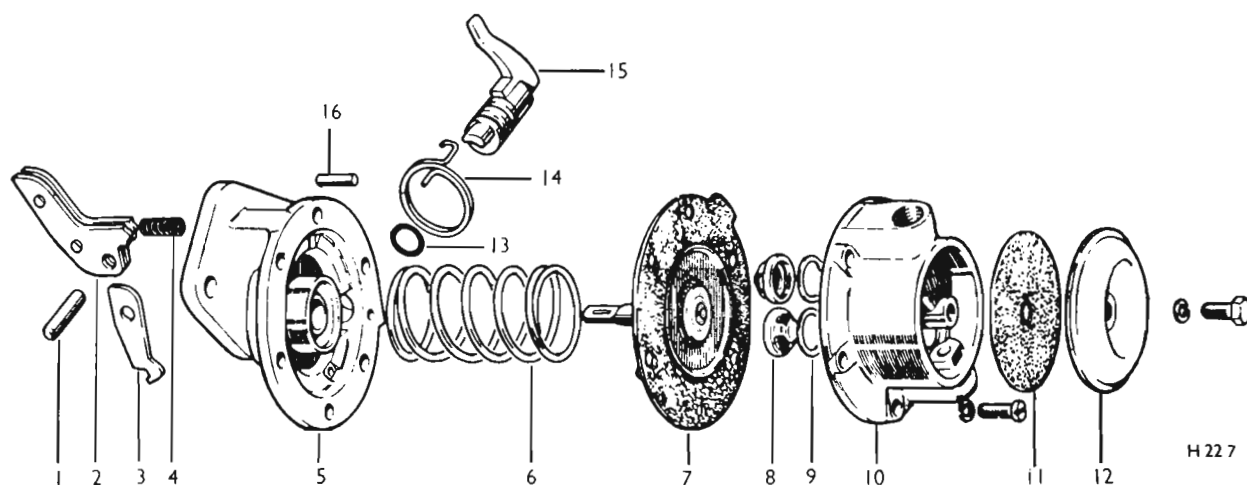
Engage the pull rod with the link and at the same time ensure that the holes in the diaphragm are aligned with those in the body flange.

Fit the bodies together by first pushing the rocker arm towards the pump body until the diaphragm is level with the body flange, place the upper body into its correct position aligning the marks made on dismantling.

Secure the bodies together, fit the securing screws and tighten sufficiently until the heads of the screws just engage the washers.

Release the rocker arm and push on the spaded end of the pull rod, to allow the piston assembly to be held at the top of its stroke, and whilst so held, tighten the securing screws diagonally and securely.

When finally assembled, the edges of the diaphragm should be approximately flush with the clamping flanges of the upper and lower bodies, any appreciable



### Key to Numbers:—

1. ROCKER ARM LINK PIN
2. ROCKER ARM
3. LINK
4. ROCKER ARM SPRING

5. LOWER BODY
6. DIAPHRAGM SPRING
7. DIAPHRAGM ASSEMBLY
8. VALVE ASSEMBLY

9. VALVE GASKET
10. UPPER BODY
11. PULSATOR DIAPHRAGM
12. COVER

13. SEALING RING
14. PRIMER SPRING
15. PRIMING LEVER
16. RETAINING PIN

Fig. B47 Exploded view of AC "VP" type fuel-lift pump

protrusion of the diaphragm will indicate incorrect fitting; special care must be taken in maintaining the downward pressure on the rocker arm, when the securing screws are finally tightened.

Finally, fit the priming lever assembly to the body, securing the retaining pin.

### To Fit

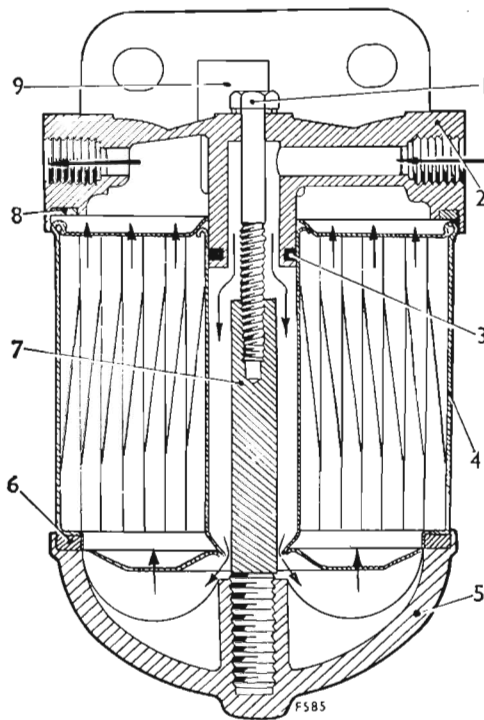
On both types of lift pumps, fit a new paper joint to the fuel-lift pump fixing flange, then tighten it down on to the mounting facing, using a non-hardening jointing compound.

Connect up the inlet and outlet fuel pipes.

Vent the fuel system (*see Section 28*).

## Section 31

## MAIN FUEL FILTER(S)



### Key to Numbers:—

- |                   |                    |
|-------------------|--------------------|
| 1. RETAINING BOLT | 5. FILTER BASE     |
| 2. FILTER HEAD    | 6. SEALING RING    |
| 3. 'O' RING       | 7. CENTRE STUD     |
| 4. ELEMENT        | 8. SEALING RING    |
|                   | 9. VENT CONNECTION |

Fig. B48 Section through typical bowl-less type fuel filter

### Maintenance

#### Single and Twin "Bowl-less" Paper Element Type

**Note.**—The internal construction of each unit forming the twin filter is the same as the single element model shown in Figure B48.

The unit consists of three basic parts, the aluminium filter head and base into which is screwed the centre stud, and finally the paper filtering element, which is strengthened by a metal container.

Fuel inlet and outlet connections are incorporated in the filter head, together with a return connection

on the clean side of the filter which is sealed from the dirty side by an "O" ring located in the filter head casting.

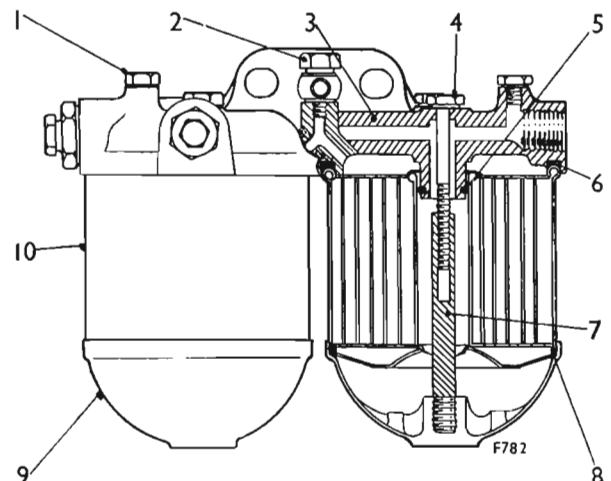
Care should be taken when dismantling, to ensure that dirt does not enter into the filter, especially on any of the sealing faces.

Unscrew the retaining bolt located in the centre of the filter head and remove the element and base, separate the element from the base.

No attempt should be made to clean the element, which should be dispensed with and a new one fitted, this is also applicable to the sealing rings.

Thoroughly wash the remaining parts in clean fuel oil and reverse the procedure of removal, fitting a new element and sealing rings, ensuring that the strengthened rim of the element is uppermost.

Refer to the instructions given in Section 28, and vent the fuel system.



### Key to Numbers:—

- |                          |                 |
|--------------------------|-----------------|
| 1. VENT PLUG             | 6. SEALING RING |
| 2. DRAIN PIPE CONNECTION | 7. CENTRE STUD  |
| 3. FILTER HEAD           | 8. SEALING RING |
| 4. RETAINING BOLT        | 9. FILTER BASE  |
| 5. "O" RING              | 10. ELEMENT     |

Fig. B49 Typical twin type bowl-less fuel filters

## Section 32

## FUEL

The following fuel specification is applicable to AEC diesel engines.

A good grade of gas oil or light diesel oil is to be preferred. Heavier diesel oils should be avoided, and on no account should any waste or residual oils be used.

The fuels supplied by any of the large distributors may be used without question. Fuels which are obtained from small local suppliers, who have no fixed source of supply, should be used with caution, and customers are recommended not to enter into arrangements for supplies over an extended period without first satisfying themselves that the supplies will come from the same source throughout the whole period of their contract.

Important factors on the suitability of a fuel for a high speed oil engine, are its source of origin and its sulphur content; the latter should on no account exceed that given in the following specification.

In all cases fuels should be to British Standard Specification as follows:—

*Description*—The fuel to be a hydrocarbon oil of petroleum and/or shale origin. To be entirely free from mineral acid, grit and other foreign impurities of all descriptions.

*Closed Flash Point*—Not to be below 175° F. (79° C.).

*Viscosity*—Measured on the Redwood No.1 Instrument at 100° F. (38° C.), not to exceed 40 seconds.

*Cloud and Pour Point*—When tested by the appropriate method given in the current issue of the Institute of Petroleum's "Standard Methods for Testing Petroleum and its Products," the pour point of the oil must not exceed 15° F. (minus 9·4° C.), nor the cloud point to exceed 24° F. minus 4·4° C.).

*Water*—Nil.

*Ash Inherent*—Not to exceed 0·005 per cent.

*Sulphur*—Not to exceed 0·75 per cent.

*Aniline Point*—When tested by the appropriate method given in the current issue of the Institute of Petroleum's "Standard Methods for Testing Petroleum and its Products," the Aniline Point should preferably be not less than 158° F. (70° C.).

Fuels of lower Aniline Point may, however, be considered providing they satisfy requirements in respect of performance.

*Performance*—The fuel must give satisfactory smooth running when tested in the engine.

## Section 33

## CLEARANCES, STANDARDS, ETC.

TYPES AV471, AV505 and AH505

(A) (i) CLEARANCE COMMON TO ALL ENGINES (when new)

Unit	Component	Clearance			
		Inches		Millimetres	
		Maximum	Minimum	Maximum	Minimum
BEARINGS	<b>DIAMETRICAL CLEARANCES</b>				
	Crankshaft and Main Bearings .. .. .	0.00465	0.00225	0.118	0.057
	Crankshaft and Connecting Rod Big-end Bearings	0.004	0.00225	0.102	0.057
	Gudgeon Pin and Connecting Rod Small-end Bearings .. .. .	0.002	0.001	0.050	0.025
	Gudgeon Pin and Piston .. .. .	0.0007	0.0003	0.019	0.008
CAMSHAFT	Camshaft and Bearings .. .. .	0.007	Interference	0.180	Interference
PISTONS	Cylinder Liner and Extreme Top of Piston ..	0.0359	0.0319	0.912	0.810
	Cylinder Liner and Bottom of Piston Skirt ..	†0.0376	0.0336	0.955	0.853
		0.0099	0.0079	0.251	0.200
		†0.0112	0.0092	0.284	0.233
VALVE GEAR	Valve and Valve Guide (Inlet) .. .. .	0.0035	0.002	0.089	0.050
	(Exhaust) .. .. .	0.00425	0.00275	0.108	0.069
	Valve Tappet and Crankcase .. .. .	0.00425	0.002	0.108	0.050
	Rocker Shaft and Rocker Bearings .. .. .	0.00325	0.00075	0.082	0.019
OIL PUMP	Oil Pump Body and Outside of Oil Pump Gears	0.0085	0.006	0.216	0.152
CRANK-SHAFT	Rear Oil Seal .. .. .	0.026	0.020	0.660	0.508
CRANK-SHAFT AND BEARINGS	<b>SIDE AND END CLEARANCES</b>				
	Crankshaft End Float .. .. .	0.013	0.004	0.330	0.102
	Crankshaft and Connecting Rod Big-end Bearing	0.012	0.007	0.305	0.177
	Cap .. .. .	††0.040	0.007	1.016	0.177
	Piston Rings and Grooves:—				
PISTON AND RINGS	Compression Ring—Top .. .. .	**0.0055	0.004	0.140	0.102
		*0.0025	0.0015	0.063	0.038
	2nd and 3rd .. .. .	**0.0045	0.003	0.115	0.076
	2nd .. .. .	*0.004	0.002	0.102	0.050
	Scraper Ring .. .. .	0.0045	0.0025	0.115	0.063
	Piston Ring Gaps:—				
	Compression Ring—Top, 2nd and 3rd ..	**0.025	0.018	0.635	0.457
	Top .. .. .	*0.025	0.018	0.635	0.457
	2nd .. .. .	*0.021	0.014	0.533	0.355
	Scraper Ring .. .. .	§0.019	0.013	0.482	0.330
OIL PUMP	Oil Pump Gears and Oil Pump Body Facing ..	†0.025	0.018	0.635	0.457
CAM-SHAFT	Camshaft End Float .. .. .	0.006	0.003	0.152	0.076
OIL PUMP	<b>AXIAL BACKLASH OF GEARS</b>				
	Crankshaft Driving Gear and Oil Pump Driving Gear .. .. .	0.010	0.008	0.254	0.203
	Oil Pump and Circulating Pump (when fitted) Driving Gears .. .. .	0.0069	0.0046	0.175	0.116
		0.004	0.0023	0.102	0.058

\*\* AV471 and AV505 engine. \* AH505 engine. § AV471 engine. † Type A505 engine. †† Reconditioning Limit Only.

## CLEARANCES COMMON TO ALL ENGINES—Continued

Unit	Component	Clearance			
		Inches		Millimetres	
		Maximum	Minimum	Maximum	Minimum
TIMING GEARS	<b>AXIAL BACKLASH OF GEARS</b> —continued				
	Timing Idler Gear and Camshaft Gear .. .. .	0.0046	0.0023	0.116	0.058
	Timing Idler Gear and Crankshaft Gear .. .. .	0.0069	0.0046	0.175	0.116
POWER STEERING PUMP WHEN FITTED)	Timing Idler Gear or Camshaft Gear and Compressor Driving Gear ..	0.0046	0.0023	0.116	0.058
	Camshaft Gear and Hydraulic Pump Idler Gear .. .. .	0.005	0.003	0.127	0.076
	Pump Idler and Driving Gears ..	0.005	0.003	0.127	0.076
RIGHT-ANGLE FAN DRIVE UNIT (WHEN FITTED)	Bevel Driven and Driving Gears ..	0.004	0.002	0.102	0.050
VALVES	<b>PROTRUSION BELOW FACE OF CYLINDER HEAD</b>				
	Inlet Valve .. .. .	0.081	0.056	2.057	1.422
	Exhaust Valve .. .. .	0.0845	0.0595	2.146	1.511

## (B) (i) STANDARDS COMMON TO ALL ENGINES

## CRANKSHAFT

Standards	Undersize	Diameter			
		Main Journals		Crank Pins	
		Maximum	Minimum	Maximum	Minimum
Plan	—	3.3455 in. 84.975 mm.	3.3445 in. 84.945 mm.	2.67675 in. 67.990 mm.	2.6760 in. 67.970 mm.
*2nd	0.010 in.	3.3355 in. 84.722 mm.	3.3345 in. 84.696 mm.	2.66675 in. 67.735 mm.	2.6660 in. 67.716 mm.
*3rd	0.020 in.	3.3255 in. 84.468 mm.	3.3245 in. 84.442 mm.	2.65675 in. 67.481 mm.	2.6560 in. 67.462 mm.
*4th	0.030 in.	3.3155 in. 84.213 mm.	3.3145 in. 84.188 mm.	2.64675 in. 67.227 mm.	2.6460 in. 67.208 mm.
*5th	0.040 in.	3.3055 in. 83.960 mm.	3.3045 in. 83.934 mm.	2.63675 in. 66.973 mm.	2.6360 in. 66.954 mm.

Note.—All journal radii  
All crank pin radii } =  $\frac{5}{32}$  in. (3.968 mm.).

\* The nitrate treated crankshaft MUST be renitrided after grinding to 0.020 in. and 0.040 in. undersizes. When regrinding it is most IMPORTANT that the fillet radius quoted above for the journals and crank pins is maintained. This is particularly important when regrinding to the 0.010 in. and 0.030 in. undersizes, as grinding to a radius less than that quoted, will cause excessive penetration of the nitrided case. For further details and procedure for this operation, apply to any AEC Service Depot or Agent.

**CRANKSHAFT REPLACEMENT BEARINGS**

Standards	Undersize	Dimensions of Precision Bearings, machined ready for fitting, to allow clearance given in Para (A) (i) between Bearing and Shaft	
		<i>Maximum</i>	<i>Minimum</i>
Plan	—	3.34915 in. = 85.068 mm.	3.34775 in. = 85.032 mm.
2nd	0.010 in.	3.33915 in. = 84.814 mm.	3.33775 in. = 84.778 mm.
3rd	0.020 in.	3.32915 in. = 84.560 mm.	3.32775 in. = 84.524 mm.
4th	0.030 in.	3.31915 in. = 84.306 mm.	3.31775 in. = 84.270 mm.
5th	0.040 in.	3.30915 in. = 84.052 mm.	3.30775 in. = 84.016 mm.

**CONNECTING ROD REPLACEMENT BEARINGS**

Standards	Undersize	Dimensions of Precision Bearings, machined ready for fitting, after the crankshaft has been ground to suit the required standard	
		<i>Maximum</i>	<i>Minimum</i>
Plan	—	2.680 in. = 68.072 mm.	2.679 in. = 68.047 mm.
2nd	0.010 in.	2.670 in. = 67.818 mm.	2.669 in. = 67.792 mm.
3rd	0.020 in.	2.660 in. = 67.564 mm.	2.659 in. = 67.538 mm.
4th	0.030 in.	2.650 in. = 67.310 mm.	2.649 in. = 67.284 mm.
5th	0.040 in.	2.640 in. = 67.056 mm.	2.639 in. = 67.030 mm.

Big-end and small-end centres 9.134 in.  $\pm$  0.002 in. = 231.953 mm.  $\pm$  0.05 mm.

**(ii) STANDARDS APPLICABLE TO TYPE 471 ENGINES****PISTONS**

	Skirt Diameter at bottom of Piston when new			
	Parallel to Gudgeon Pin		At Right Angles to Gudgeon Pin	
	<i>Maximum</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Minimum</i>
Wellworthy	4.3958 in. 111.653 mm.	4.3938 in. 111.602 mm.	4.4020 in. 111.810 mm.	4.4010 in. 111.785 mm.

**CYLINDER LINERS**

Diameter of bore when new after honing	
<i>Maximum</i>	<i>Minimum</i>
4.4109 in. 112.038 mm.	4.4099 in. 112.013 mm.

## (iii) STANDARDS APPLICABLE TO TYPE 505 ENGINES

## PISTONS

	Skirt Diameter at bottom of Piston when new			
	Parallel to Gudgeon Pin		At Right Angles to Gudgeon Pin	
	Maximum	Minimum	Maximum	Minimum
Wellworthy	4.5473 in. 115.501 mm.	4.5453 in. 115.450 mm.	4.5538 in. 115.666 mm.	4.5528 in. 115.641 mm.
Wellworthy (Low Friction Type)	4.5538 in. 115.666 mm.	4.5528 in. 115.641 mm.	4.5538 in. 115.666 mm.	4.5528 in. 115.641 mm.

## CYLINDER LINERS

Diameter of bore when new after honing	
Maximum	Minimum
4.564 in. 115.925 mm.	4.563 in. 115.900 mm.

## (C) (i) TORQUE SPANNER LOADINGS FOR TYPES 471 AND 505 ENGINES

**Important:**—All threads should be thoroughly cleaned and lubricated with engine oil before assembly.  
The torque loadings quoted below must be strictly adhered to.

Part	Torque	
	lb. ft.	Kg. M.
†Main bearing setscrews .. .. .	160	22.1
Camshaft gear setbolts .. .. .	60	8.3
Crankshaft pulley setscrew .. .. .	250	34.5
*Connecting rod bolt nuts .. .. .	80	11.0
Cylinder head stud nuts .. .. .	100	13.8
Cylinder head studs .. .. .	40	5.5
Injector stud nuts .. .. .	11	1.5
*Flywheel bolt nuts .. .. .	85	11.7
Oil pump driving gear nut .. .. .	30	4.1
Fuel-delivery pipe union nuts .. .. .	12-15	1.6-2.1
Water pump impeller nut .. .. .	25	3.4
	lb. in.	Kg. cm.
Fuel delivery valve holder—"In-line" type pump ..	400	460

\* Should the split pin hole not align after tightening these nuts to the specified torque given above, the nut may be **tightened** to the next slot for insertion of the split pin.

† It is most important, that when tightening main bearing setscrews, the operation is fully completed, and must not be discontinued until the setscrews are tightened to their correct torque loading.

## (D) (i) SHIMS, THRUST STRIPS, ETC., AVAILABLE FOR TYPES 471 AND 505 ENGINES

Part	Inches	Millimetres	Remarks
Camshaft end float shims .. .. .	{ 0.036 0.064 0.124	0.914 1.625 3.150	Thick
Crankshaft thrust strips .. .. . Plan ..	{ 0.091 0.093 0.100 0.103 0.110 0.113 0.120 0.123	2.311 2.362 2.540 2.616 2.794 2.870 3.048 3.124	
2nd. Std ..			
3rd. Std ..			
4th Std. ..			
*Cylinder head gaskets, for use with re-surfaced mono-bloc			
Amount flashed off surface:—			
1st Std. 0.005 in. (0.127 mm.) .. .. .	Plan	—	
2nd Std. 0.010 in. (0.254 mm.) or 0.015 in. (0.381 mm.)	0.011	0.279	Increased thickness of gasket above plan size
3rd Std. 0.020 in. (0.508 mm.) or 0.025 in. (0.635 mm.)	0.021	0.533	
4th Std. 0.030 in. (0.762 mm.) or 0.035 in. (0.889 mm.)	0.031	0.787	
Right-angle Fan drive unit shims .. .. .	{ 0.003 0.005 0.010	0.076 0.127 0.254	Thick
Rocker arm adjusting washers .. .. .	{ 14 18 24	— — —	
	I.W.G.		
Valve guide (inlet and exhaust) .. .. .	{ 0.7293 0.729	18.526 18.519	Outside diameter
Valve seat (inlet and exhaust) for pressing into cylinder heads after machining .. .. .	—	—	
			First and second service sizes

\* For use when reconditioning an engine.

**Note.**—For details of dimensions and procedure for fitting detachable water pump wearing sleeves, apply to any AEC Service Depot or Agent.

**NOTES**

NOTES

# PART C28

## CLUTCH

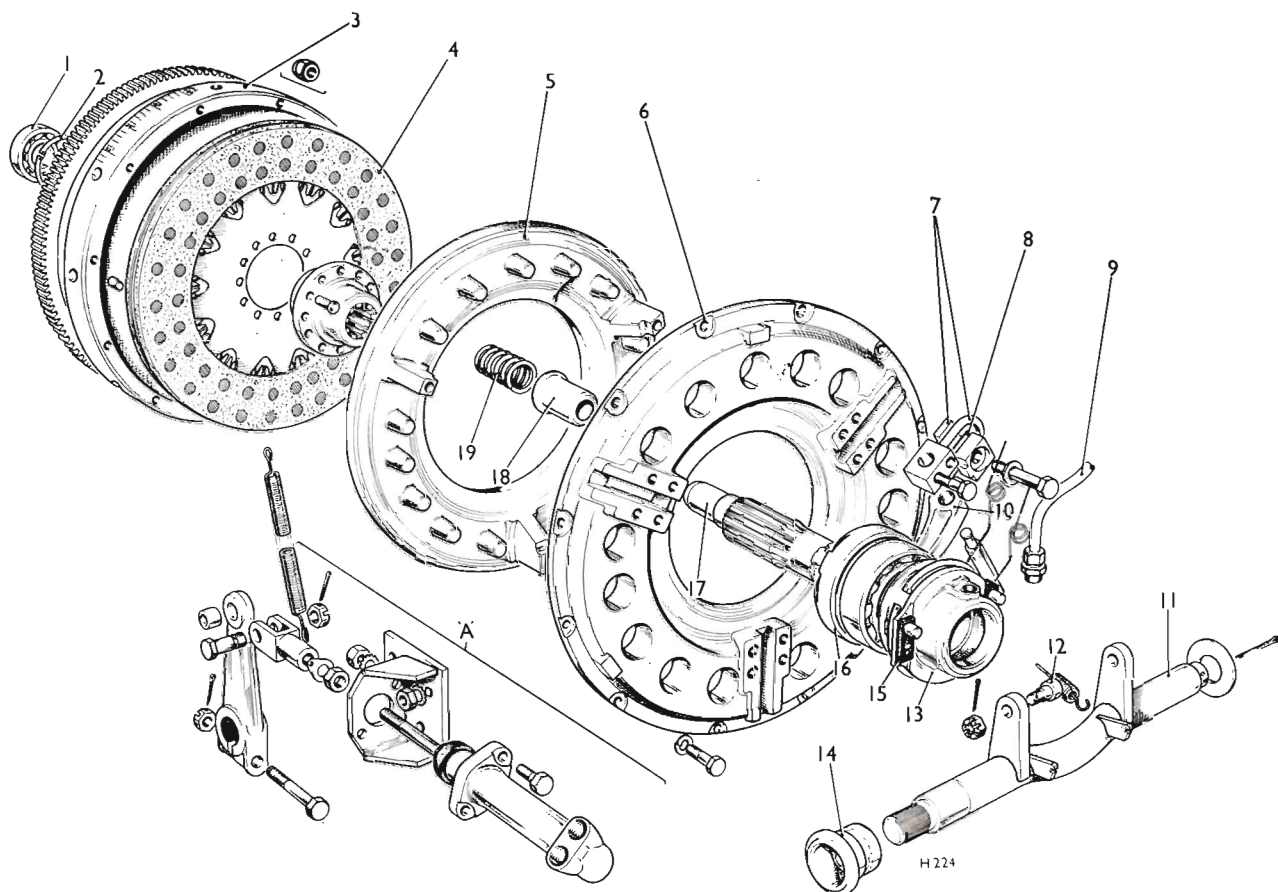
### (DRY PLATE)

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## Section 1

## CLUTCH



## Key to Letter and Numbers:—

"A" SLAVE HYDRAULIC CYLINDER ASSEMBLY

- 1. PILOT BEARING—PRIMARY SHAFT
- 2. CIRCLIP
- 3. FLYWHEEL
- 4. DRIVEN PLATE
- 5. PRESSURE PLATE
- 6. COVER PLATE
- 7. PACKING PIECES (TRANSPORTATION PURPOSES ONLY)

- 8. PAD—PRESSURE PLATE
- 9. LUBRICATION PIPES—WITHDRAWAL BEARING
- 10. RELEASE LEVER
- 11. WITHDRAWAL SHAFT
- 12. PEG—WITHDRAWAL SHAFT
- 13. INNER HOUSING—WITHDRAWAL BEARING
- 14. BUSH—WITHDRAWAL SHAFT

- 15. PAD—WITHDRAWAL BEARING
- 16. OUTER HOUSING—WITHDRAWAL BEARING
- 17. PRIMARY SHAFT
- 18. SPRING CAGE
- 19. PRESSURE SPRING

Fig. C1 Exploded view of clutch and withdrawal gear

## To Remove

Remove the gearbox from the vehicle (see Part A).

To remove the clutch cover plate from the flywheel, slacken the securing bolts **evenly and a little at a time** until the spring pressure is released; withdraw the bolts and remove the clutch assembly and the driven plate.

**Note:**—When the driven plate requires relining, it is recommended that the complete plate be returned to any AEC Depot or Agent and a reconditioned plate obtained in exchange.

## To Dismantle (see Fig. C1).

**Note:**—**Before dismantling**, ensure that the original balance of the clutch is maintained by marking the **cover, pressure plate** and the **release levers** to indicate their original positions on assembly.

Using the special pressure plate compressing tool, listed in the Maintenance Equipment, or a suitable hand press, compress the pressure plate against the springs in the cover plate.

Remove the setscrews and washers which secure the pressure pads and remove the pads and shims.

Gradually release the spring pressure; remove the compressing tool and lift the cover plate clear of the pressure plate. Remove the spring cages and springs.

Remove the setbolts and washers which secure the release lever brackets to the cover plate; remove the assemblies and detach the anti-rattle springs, brackets and distance washers from the release lever pins. Remove the pins from the levers.

Certain clutch assemblies have a detachable rubbing plate secured to the flywheel, which, if necessary, can be removed after the clutch has been separated from the flywheel.

### To Assemble

Check the loading of the clutch pressure springs and renew any spring which does not conform to the following requirements:—

The free length of each spring should be 4.25 in. (108 mm.).

The load required to compress each spring to its working length of  $2\frac{1}{16}$  in. (68 mm.) should be 150 lb. (68 Kg.).

Check the bearing face of the pressure plate for cracks and score marks and the driven plate for worn linings and loose centre plate rivets.

Ensure that all parts are clean and free from oil and grease.

Insert the pin into each release lever and fit a distance washer over the protruding ends of the pin, followed by the release lever brackets.

Position each release lever assembly on the cover plate, ensure that the markings coincide and fit the securing setbolts and washers. Fit the anti-rattle springs over the ends of the release lever pins.

Place the pressure springs and cages in position on the pressure plate and position the cover plate on the pressure plate, ensuring that the markings coincide and the spring cages pass through the holes in the cover plate.

Using the pressure plate compressing tool, listed in the Maintenance Equipment, carefully compress the assembly and ensure that the pressure springs and cages remain in position and that the projections on the pressure plate pass through the slots in the cover plate.

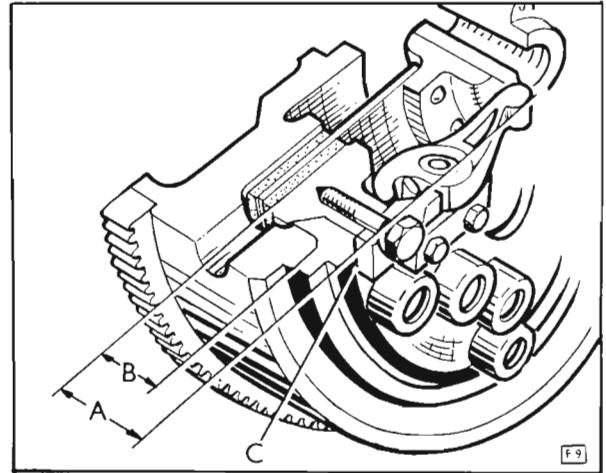
Place the pressure pad shims in position, followed by the pads and fit the securing setscrews and washers.

Finally, adjust the release levers as instructed under "To Adjust".

### To Adjust (see Fig. C2)

Satisfactory operation of the clutch is dependent upon the correct adjustment of the release levers.

Adjustment of the levers is made by adding or subtracting shims beneath the pressure pads (for Dimensions of Shims Available see Section 5).



### Key to Letters:—

- A. MEASUREMENT FOR RELEASE LEVER  
ADJUSTMENT  $2.565 \pm 0.005$  in. ( $65.2 \pm 0.13$  mm.)
- B. MEASUREMENT FOR PRESSURE PLATE  
ADJUSTMENT  $1$  in.  $\pm 0.002$  in. ( $25.4 \pm 0.05$  mm.)
- C. SHIMS TO OBTAIN MEASUREMENT "A"

Fig. C2 Clutch release lever setting dimensions

It should be noted that a change of shim thickness of 0.001 in. (0.03 mm.) will move the release lever pad face approximately 0.005 in. (0.13 mm.).

With the clutch unit clamped in the pressure plate compressing tool, and the gauge fitted to the centre post, adjust the release levers by adding or subtracting shims beneath the pressure pads until the pad face of the release levers just contact the flange on the gauge, which is equivalent to  $2.565$  in.  $\pm 0.005$  in. ( $65.2$  mm.  $\pm 0.13$  mm.), measured from the bearing face of the pressure plate to the pad face of each release lever (Dimension "A" Fig. C2).

An alternative method, if the pressure plate compressing tool is not available, is to compress the pressure plate assembly in a suitable press until dimension "B" is obtained, which is the distance of the flywheel mating face of the spring cover plate above the bearing face of the pressure plate. When this dimension has been obtained, adjust the release levers to the dimensions given above.

If either of the above methods cannot be applied, proceed as follows:—

With the clutch unit bolted to the flywheel, insert the driven plate aligning mandrel, listed in the Maintenance Equipment, through the splined hub of the driven plate so that the spigot end of the mandrel is located in the pilot bearing in the end of the crankshaft.

Place the positioning collar, listed in the Maintenance Equipment, on the mandrel so that the machined face of the flange is facing the release levers and is hard against the shoulder on the mandrel.

Adjust each release lever so that the pad face of the lever just contacts the face of the collar.

**To Fit**

Grease the gearbox primary shaft pilot bearing, located in the end of the crankshaft.

Insert the alignment mandrel into the splined hub of the driven plate and fit the spigot end of the mandrel into the primary shaft pilot bearing, thus correctly aligning the driven plate.

**Note:**—The driven plate is fitted with the **long boss of the hub towards the gearbox**.

Position the clutch assembly on the flywheel so that

it is located on the dowels and fit the securing setbolts and spring washers and tighten the bolts **progressively**.

Withdraw the mandrel and fit the gearbox as instructed in Part A.

**Note:**—When fitting the gearbox, ensure that the engine/gearbox securing bolt, adjacent to the top of the clutch operating lever (*see Fig. C6*), is fitted with its head towards the gearbox and that the anchor plate for the slave cylinder push rod pull-off spring is fitted to the appropriate bolt.

## Section 2 CLUTCH WITHDRAWAL BEARING ASSEMBLY

Remove the clutch withdrawal bearing assembly as instructed in Part D.

**To Dismantle** (*see Fig. C3*)

Detach the restraint springs from the inner bearing housing and, using a suitable press, remove the bearing assembly from the inner housing.

Remove the circlip and the grease retainer from the outer housing and drive out the bearing by inserting a suitable drift alternately into the holes provided in the housing.

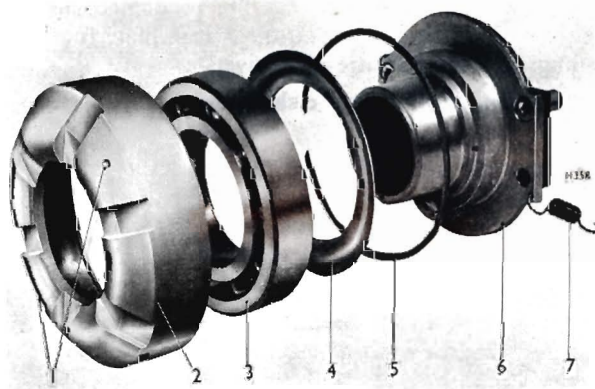
**To Assemble**

Reverse the procedure for dismantling noting the following points:—

**Key to Numbers:—**

- |                            |                          |
|----------------------------|--------------------------|
| 1. BEARING EXTRACTOR HOLES | 5. CIRCLIP               |
| 2. OUTER BEARING HOUSING   | 6. INNER BEARING HOUSING |
| 3. BEARING                 | 7. RETURN SPRING         |
| 4. GREASE RETAINER         |                          |

Fig. C3 Exploded view of clutch withdrawal bearing assembly



## Section 3 CLUTCH OPERATING SYSTEM

**Method of Operation** (*see Figs. C4, C5 and C6*)

**The hydraulic slave cylinder** (*see Fig. C4*) contains a piston and a rubber seal which moves inside the cylinder.

A push rod positioned in the end of the piston is connected to the clutch operating lever.

Dirt and water are prevented from entering the assembly by a rubber cap fitted to the cylinder barrel.

A bleed screw is fitted in the cylinder, adjacent to the fluid delivery pipe.

A pull-off spring connected between the push rod and the clutch housing (*see Fig. C6*) prevents the piston from fully returning to the rear of the cylinder, thereby allowing for wear of the clutch linings.

**The hydraulic master cylinder** (*see Fig. C5*) is mounted on the rear end of the pedal bracket assembly, or on the frame and is connected to the clutch pedal lever.

Thoroughly clean all parts in clean paraffin; examine the bearing for wear and pitting of the race; also examine the rubbing pads on the withdrawal lever and renew if necessary.

Pack the bearing with grease before assembling it to the housing (*see Part S*).

The cylinder contains a piston to which is fitted a rubber seal, and a valve which controls the fluid from the supply tank; these are operated by a push rod coupled to the clutch pedal lever.

The clutch pedal return spring is fitted over the push rod and is located by special front and rear locating washers. The rear washer is recessed to fit the rear end of the rubber boot which protects the assembly, or alternatively, the return spring is located by conventional linkage to the pedal boss and frame.

On depressing the clutch pedal, the piston is moved forward and in the first  $\frac{1}{32}$  in. (0.8 mm.) of travel the centre valve closes the inlet port. As the piston continues to move forward, fluid is forced through the outlet port to the slave cylinder which operates the clutch withdrawal mechanism.

When the clutch pedal is released the pedal return spring returns the pedal to its correct position and, at the same time, the piston return spring returns the piston to its original position and the final movement of the piston lifts the valve off its seating and fluid is able to return to the supply tank or to flow from the supply tank if the system is not fully charged.

### To Flush

Should the hydraulic fluid become thick or gummy after considerable usage, the system must be drained, flushed out and refilled.

Using a rubber bleed tube, connect one end of the tube to the bleed screw on the hydraulic slave cylinder and place the other end in a suitable container.

Unscrew the bleed screw one complete turn and operate the clutch pedal until all the fluid is expelled from the system.

Fill the supply tank with **industrial methylated spirit** and flush the system by operating the clutch pedal repeatedly until the methylated spirit flows in a clean condition from the system.

Remove the master cylinder and drain it of any remaining spirit.

**Note:**—If the fluid in the system becomes contaminated by mineral oil etc., the flushing process will not be effective. The various units must be dismantled, cleaned, and all rubber parts and flexible hoses must be **renewed**.

Refit the master cylinder; fill the supply tank with clean hydraulic fluid and bleed the system.

### To Bleed

If any part of the system has been disconnected, or if the system has been operated with insufficient fluid in the supply tank, thus permitting air to be drawn in, or if the operation of the clutch pedal becomes “spongy”, the system must be bled to expel the air.

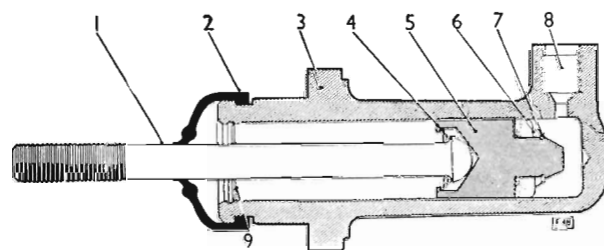
Top up the supply tank to three-quarters full and **keep it at least a quarter full during the bleeding operation.**

Connect one end of the rubber bleed tube to the bleed screw on the hydraulic slave cylinder and place the other end in a suitable glass container.

Using clean hydraulic fluid, fill the glass container just sufficiently to submerge the end of the bleed tube; **ensure to keep the end of the tube submerged during the bleeding operation.**

Unscrew the bleed screw one complete turn and, using a second operator, slowly depress the clutch pedal to its limit and allow it to return freely.

Tighten the bleed screw at the end of each downward movement of the pedal.



#### Key to Numbers:—

- |                              |  |
|------------------------------|--|
| 1. PUSH ROD                  | 6. OIL SEAL AND RETAINING WASHER                 |
| 2. RUBBER CAP                | 7. CIRCLIP                                       |
| 3. CYLINDER                  | 8. HYDRAULIC FLUID CONNECTION TO MASTER CYLINDER |
| 4. PUSH ROD RETAINING SPRING | 9. CIRCLIP                                       |
| 5. PISTON                    |  |

Fig. C4 Section through typical hydraulic slave cylinder

Repeat operating the clutch pedal and, during each downward stroke, observe the flow of the fluid into the container and check for air bubbles. When air bubbles cease to appear, tighten the bleed screw during the **downward** movement of the clutch pedal.

Remove the bleed tube; wipe the area clean and check for leaks whilst the operator depresses and releases the clutch pedal.

Check the level of the fluid in the supply tank and top-up as necessary.

**Do not use the fluid which has been bled from the system.**

### Hydraulic Slave Cylinder (see Fig. C4)

#### To Remove

Drain the hydraulic system and disconnect the fluid delivery pipe from the slave cylinder.

Disconnect the pull-off spring and remove the fork-end pin from the clutch operating lever.

Remove the securing bolts and detach the slave cylinder from the mounting bracket.

#### To Dismantle

Remove the fork-end, spring clip and the locknut from the push rod.

Remove the rubber cap and the circlip (when fitted).

Withdraw the push rod and piston complete with oil seal.

Remove the circlip, retaining washer and the oil seal from the piston.

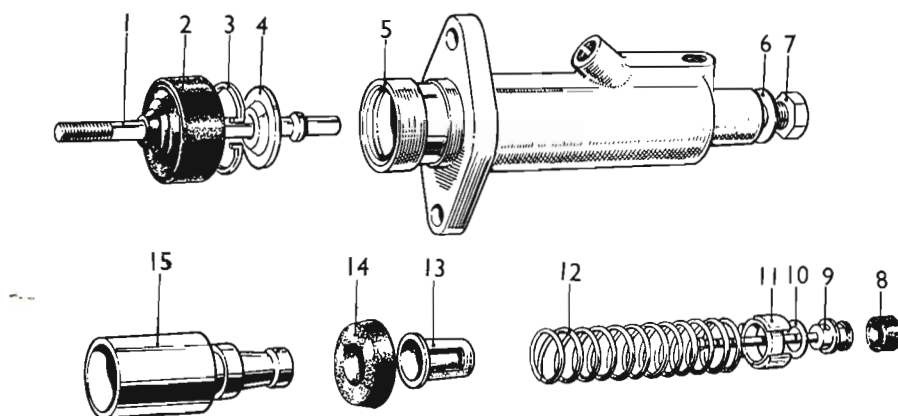
Remove the retaining spring and push rod from the piston.

#### To Assemble

When handling the parts, **absolute cleanliness** is essential.

**Key to Numbers:—**

1. PUSH ROD
2. DUST EXCLUDER
3. CIRCLIP
4. DISHED WASHER
5. CYLINDER
6. WASHER
7. END PLUG
8. VALVE SEAL
9. VALVE AND STEM
10. SPRING WASHER
11. VALVE SPACER
12. SPRING
13. SPRING THIMBLE
14. PISTON SEAL
15. PISTON



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**Fig. C5 Exploded view of a typical Girling master hydraulic cylinder (pedal bracket mounted)**

Clean the oil seal in **clean hydraulic fluid only**.

Clean the remaining components and ensure that all traces of the cleaning agent are removed before assembling.

Examine the seal and the rubber cap for signs of deterioration and renew as necessary.

Position the seal on the piston, with its flat face towards the piston, and fit the retaining washer and circlip.

Insert the push rod into the piston and fit the retaining spring and circlip.

Dip the piston assembly in **clean hydraulic fluid** and fit the assembly into the cylinder.

Fit the retaining circlip and the rubber cap.

Refit the locknut, spring clip and fork-end to the push rod.

**To Fit**

Reverse the procedure for removal. Bleed the hydraulic system as instructed under **"To Bleed"** and reset the clutch operating mechanism as instructed in Section 4.

**Hydraulic Master Cylinder (see Fig. C5)****To Remove**

Tilt the cab (*when applicable*) as instructed in Part A.

Drain the hydraulic system by attaching a rubber bleed tube to the bleed screw on the slave hydraulic cylinder, unscrew the bleed screw a complete turn and pump out the fluid, into a suitable container, by operating the clutch pedal.

Disconnect the hydraulic pipes from the cylinder and blank off the open ends of the pipes.

Disconnect the push rod fork-end from the clutch pedal lever.

**On pedal bracket mounted type**, remove the bolt which secures the upper part of the master cylinder adaptor plate to the pedal bracket and then remove the

bolt from the flange on the underside of the cylinder. At this stage, it is not necessary to remove the bolt from the upper part of the cylinder flange.

The master cylinder assembly can now be removed by withdrawing the gaitered section through the pedal bracket.

**On frame mounted type**, remove the bolts securing the cylinder to the frame.

**To Dismantle****Pedal Bracket-Mounted Type**

Remove the bolt securing the adaptor plate to the cylinder flange and slide the adaptor plate off over the rubber gaiter.

Remove the fork-end and locknut from the push rod and detach the rubber gaiter complete with the spring locating washer, and then remove the return spring and the front locating washer.

Remove the internal circlip and withdraw the push rod complete with the dishd washer.

Withdraw the piston and valve assembly complete and separate the assembly by lifting the thimble leaf over the shoulder of the piston. Carefully remove the seal from the piston.

Depress the piston return spring so that the valve stem slides through the keyhole in the thimble, thus releasing tension on the spring.

Detach the valve spacer, taking care to retain the spacer spring washer which is located under the valve head. Remove the seal from the valve head.

**Frame Mounted Type**

Remove the rubber gaiter from the push rod.

Remove the end plug and withdraw the return spring and seal retainer.

Detach the circlip retaining the dishd washer and

remove the push rod; slide the piston out from the cylinder and detach the rod cup and seal.

Remove the oil seal and restrictor ring from within the cylinder.

### To Assemble

When handling the parts **absolute cleanliness** is essential.

Examine the rubber seals and gaiter for signs of deterioration, and renew as necessary.

Clean the seals in **clean hydraulic fluid only** and when cleaning the remaining components, ensure that all traces of the cleaning agent are removed before assembling.

#### Pedal Bracket-Mounted Type

Fit the valve seal, with the flat side correctly seated on the valve head and assemble the spring washer with its domed side against the underside of the valve head. Secure the spring washer in position by fitting the valve spacer with its legs towards the valve seal.

Fit the piston return spring centrally on the spacer and insert the thimble into the other end of the spring and then compress the spring until the valve stem engages through the keyhole in the thimble. Ensure that the stem is correctly located in the centre of the thimble.

Fit a new seal to the piston, with the flat side of the seal seated against the face of the piston.

Insert the reduced end of the piston into the thimble until the thimble engages under the shoulder of the piston and then press down the thimble leaf so that it will engage with the shoulder on the reduced end of the piston.

Dip the assembly in **clean hydraulic fluid** and insert the assembly into the cylinder, valve end first, taking care to ease the lip of the piston seal into the bore.

Fit the push rod, with the dished side of the washer under the spherical head, into the cylinder, followed by the internal circlip.

Position the pedal return spring locating washer on the push rod so that the flat face is located on the end of the cylinder.

Position the return spring over the push rod and

ensure it is correctly located on the front locating washer, then slide the rubber gaiter over the spring and compress the spring until the threaded end of the push rod emerges through the rear locating washer, which is retained in the end of the gaiter, and fit the locknut.

Ensure that the lower end of the gaiter fits correctly over the outer diameter of the cylinder.

The master cylinder adaptor plate must now be fitted as follows:—

Position the cylinder horizontally in a vice and with the oil ports uppermost.

Slide the adaptor plate over the rubber gaiter and position it against the cylinder mounting flange so that the two-holed end of the plate is uppermost.

Secure the plate to the cylinder flange by fitting the bolt, with its head towards the push rod, through the hole in the plate which aligns with the upper hole of the cylinder flange. Fit the fork-end to the push rod.

#### Frame Mounted Type

Fit the piston seal and push rod cup to the end of the piston, dip in **clean hydraulic fluid** and then insert the restrictor ring and seal (in that order) into the cylinder; ensure that the lips on the seals face towards the end plug.

Insert the push rod and locate with the dished washer and circlip.

Locate the seal retainer between the lips of the recuperating seal; fit the return spring into the piston and secure with the end plug and gasket.

Finally, fit the gaiter and locknut.

### To Fit

Reverse the procedure for removal noting the following points:—

When connecting the push rod fork-end to the clutch pedal lever, ensure that it is connected to the **upper hole** in the lever.

Reset the clutch “free pedal” movement as instructed in Section 5.

Fill the hydraulic system with the correct grade of oil (*see Part A*) and bleed the system as instructed under “**To Bleed**”.

## Section 4

## CLUTCH OPERATING MECHANISM

### To Adjust (*see Fig. C6*)

Periodical adjustment of the hydraulic slave cylinder push rod is unnecessary. If however, either of the hydraulic cylinders have been removed, or a new driven plate is fitted, or the clutch operating lever has been removed, proceed as follows:—

Bleed the hydraulic system as instructed under “**To Bleed**” in Section 3.

Detach the pull-off spring from the anchor plate on the push rod.

Remove the fork-end pin which secures the push rod to the clutch operating lever and slacken the fork-end locknut.

Using the push rod, push the piston to the rear of the slave cylinder, and ensure that the piston has reached the limit of its travel.

Hold the push rod in this position and adjust the fork-end to dimension "B". Fig. C6, measured from the centre of the fork-end pin hole to the front of the slave cylinder mounting bracket.

When this dimension has been obtained, correctly position the pull-off spring anchor plate, ensure that the fork-end is correctly aligned for the clutch operating lever and then tighten the locknut to secure the fork-end.

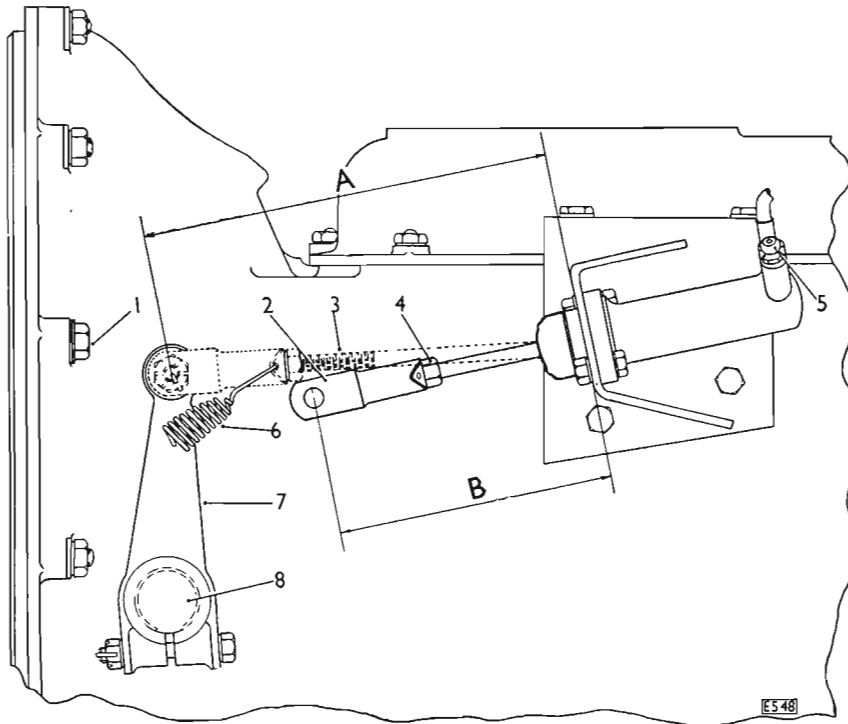
Remove the split pin and slacken the clutch operating lever clamp bolt and withdraw the lever from the shaft.

Turn the clutch withdrawal shaft until the withdrawal levers are hard against the withdrawal bearing; hold the withdrawal shaft in this position and fit the clutch operating lever to the splines on the shaft so that dimension "A" Fig. C6, is obtained, measuring from the centre of the securing pin hole in the lever to the front face of the slave cylinder mounting bracket.

Tighten the lever clamp bolt and lock the nut with the split pin.

Align the push rod fork-end with the lever, fit the securing pin and connect the pull-off spring.

**Refer to Part A for the clutch pedal adjustment.**



#### Key to Numbers:—

1. GEARBOX/ENGINE SECURING BOLT HEAD
2. POSITION OF FORK-END FOR ADJUSTMENT
3. PUSH ROD
4. LOCKNUT
5. BLEED SCREW
6. PULL-OFF SPRING
7. CLUTCH OPERATING LEVER
8. CLUTCH WITHDRAWAL SHAFT

#### Key to Letters:—

##### A. DIMENSION FOR CLUTCH OPERATING LEVER ADJUSTMENT

$8\frac{1}{2}$ in. $\pm \frac{1}{8}$ in. (223.8 mm. $\pm 8.0$ mm.)— TGM CHASSIS	} 1 in. (25.4 mm.) SLAVE CYLINDER BORE
$8\frac{1}{2}$ in. $\pm \frac{1}{8}$ in. (220.6 mm. $\pm 8.0$ mm.)— RELIANCE AND SWIFT "505" CHASSIS WITH SYNCHROMESH GEARBOX	
$8\frac{1}{2}$ in. $\pm \frac{1}{8}$ in. (222.3 mm. $\pm 8.0$ mm.) TGM AND 4M4 CHASSIS	} $1\frac{1}{2}$ in. (31.7 mm.) SLAVE CYLINDER BORE

##### B. DIMENSION FOR HYDRAULIC SLAVE CYLINDER ADJUSTMENT

6 in. (152.4 mm.)—TGM CHASSIS	} 1 in. (25.4 mm.) SLAVE CYLINDER BORE
$5\frac{1}{2}$ in. (147.6 mm.)—RELIANCE AND SWIFT "505" CHASSIS WITH SYNCHROMESH GEARBOX	
$6\frac{1}{2}$ in. (165.1 mm.) TGM AND 4M4 CHASSIS	} $1\frac{1}{2}$ in. (31.7 mm.) SLAVE CYLINDER BORE

**Note:**—The above dimensions for the "TGM" type chassis, (1 in. slave cylinder bore) are also applicable to the Reliance "505" when fitted with a Constant Mesh Gearbox.

**Fig. C6 Dimensions for adjusting clutch operating mechanism**

## Section 5

## DIMENSIONS OF SHIMS AVAILABLE

Alternative shims listed hereunder are supplied to enable the correct clearances to be obtained during assembly; refer to the "Spare Parts Catalogue" for part numbers

#### Part

#### Thickness

Release lever pressure pad .. .. .	$\left\{ \begin{array}{l} 0.030 \text{ in. (0.762 mm.)} \\ 0.015 \text{ in. (0.381 mm.)} \\ 0.005 \text{ in. (0.127 mm.)} \\ 0.002 \text{ in. (0.051 mm.)} \end{array} \right.$
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# PART D 29

## GEARBOX

D29

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## Section 1

## GEARBOX

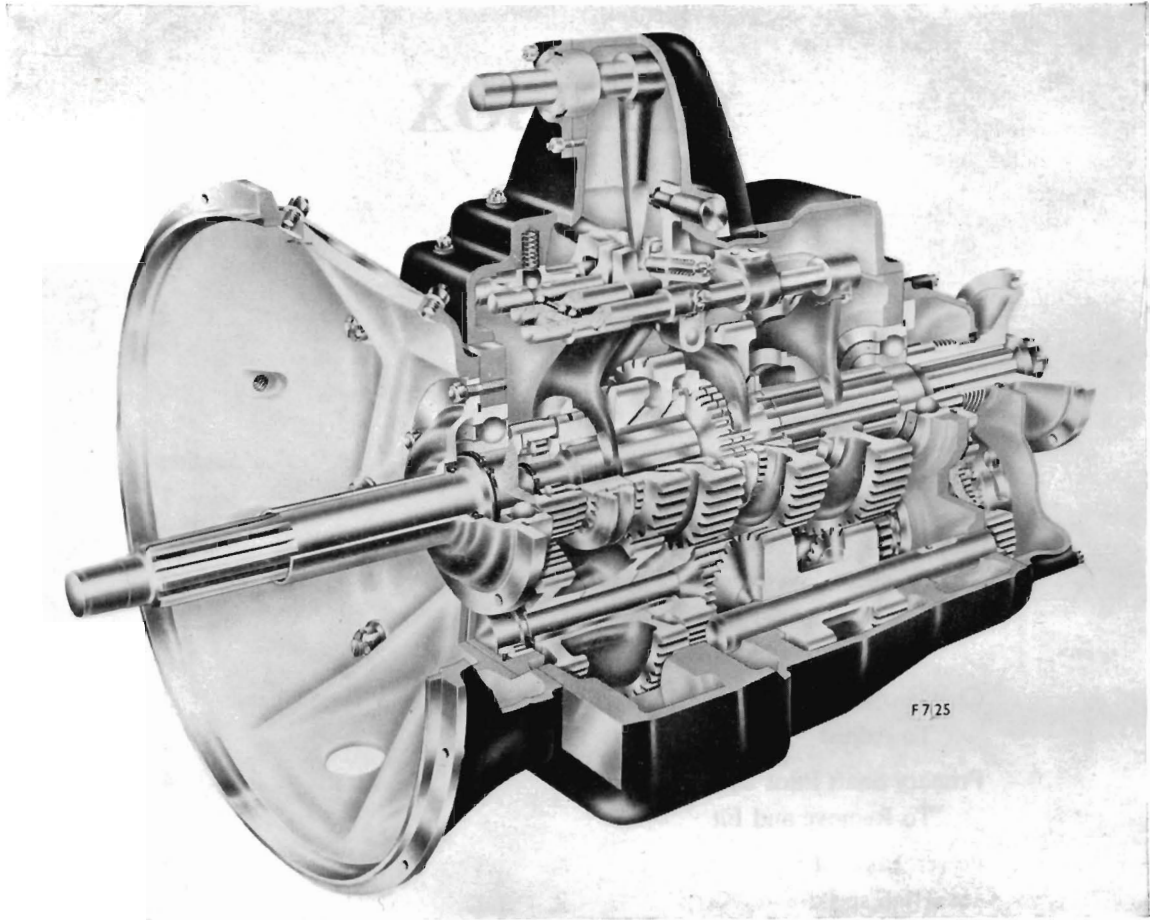


Fig. D1 Cut-away view of 6 speed gearbox

**To Dismantle** (see Figs. D1, D2, D3 and D4)

Remove the drain plug (on certain gearboxes the drain plug is fitted on the main gearbox casing) drain the oil, and remove the unit from the vehicle (see Part A.)

**Clutch Withdrawal Housing**

Detach the clutch withdrawal bearing lubrication pipe by unscrewing the nut on the bearing housing, and unscrewing the hexagon of the adaptor on the bell housing.

Unhook the withdrawal housing restraint spring and slide off the clutch withdrawal bearing complete with its housing.

To dismantle the clutch withdrawal bearing see Part C.

**Clutch Withdrawal Shaft**

Mark the clutch operating lever and clutch with-

drawal shaft to indicate their relative positions for subsequent assembly.

Slacken the clamping bolt on the operating lever and remove the lever from the shaft.

Tap out the flanged bush from the near side of the housing and drive out the taper pin from the collar fitted at the opposite end of the shaft.

Detach the collar and slide the withdrawal shaft far enough into the unbushed hole until the opposite end is free from its bush; remove the shaft from the bell housing.

**Bell Housing**

Unscrew the nuts (which may be split pinned or self locking) securing the bell housing to the gearbox casing, then drive off the housing using a lead hammer.

**It should be noted that the bell housing need not be removed unless removal of the layshaft, or when fitted, idler gear shaft for the high speed power take-off unit is necessary.**

### Selector Mechanism (see Figs. D4 and D5)

After disconnecting the change-speed shaft at the muff coupling, the selector mechanism can, if required, be removed as a complete unit (without removing the gearbox from the vehicle) as follows:—

Place the gears in the neutral position, remove the nuts and bolts and lift off the selector mechanism assembly complete.

To dismantle, turn the casing over so that the selector assembly is on top, then unscrew the nuts securing the selector rod brackets. Care should be taken to hold the selector mechanism in position until all compression on the indent ball springs is released. Remove the bolts and selector mechanism from the cover followed by the springs and indent balls.

Free the striking lug on the 1st speed and reverse selector rod by removing the locking wire and unscrewing the setscrew. Then drive the selector rod complete with fork from the end of the bracket and detach the striking lug. Remove the locking wire and setscrew and remove the selector fork from the rod.

Slide the front and rear brackets from the rod ends being careful not to lose the interlock balls retained in the front bracket; then remove the interlock slug from the 2nd and 3rd speed rod. **On 6 speed gearboxes**, remove the second interlock slug from the 4th and 5th speed rod.

Remove the locking wire and setscrews from the 2nd and 3rd, 4th and 5th, and when fitted, the 6th speed selector forks; drive the forks from the ends of the rods.

To remove the 1st speed and reverse relay link from the cover, release the circlip on the pivot pin. Unscrew the nut retaining the spring loaded plunger on the relay link and withdraw the plunger and spring.

Using a small drift, drive the relay link pivot pin out from the inside of the casing.

**On late gearboxes**, remove the locknut and washer securing the pivot pin to the selector cover; drive the pin out from the outside of the casing.

### Striking Gear

Unscrew the nuts retaining the bearing cap to the selector housing and remove the cap, shims and spherical bearing. If necessary, detach the rubber "O" rings from the cap and bearing.

Remove the striking lever by withdrawing the lever end from the inside of the selector cover.

### Extension Casing

Unscrew the nut retaining the output coupling flange and draw the flange off the shaft with the tool listed in the Maintenance Equipment.

Slacken the bolt clamping the split boss of the speedometer drive housing and remove the eccentric bush and driven gear. The driven gear on the early 5 speed gearbox, unless prevented, will fall into the casing during the removal of the bush.

Remove the extension casing.

### Mainshaft

**When the gearbox is fitted with 6th speed gears, the following must be removed from the layshaft before proceeding with the removal of the mainshaft.**

Remove the locking wire and setscrew securing the lug to the 6th speed relay rod and withdraw the rod complete with selector fork. The lug will be detached during the withdrawal of the rod together with the 6th speed engagement dog. Remove the locking wire and setscrew to release the selector fork from the rod.

Remove the circlip from the rear of the layshaft, followed by the washer, 6th speed gear and bush.

**For both 5 and 6 speed gearboxes proceed as follows:—**

Remove the locking wire, retaining nuts and bearing keep ring from the rear casing.

To release the rear bearing from the casing, temporarily fit the coupling flange to the mainshaft and, with a hide or lead hammer, strike the coupling flange and drive the shaft out towards the rear of the case. The shaft should only be driven as far as the 1st speed gear wheel permits.

Remove the coupling flange and, if necessary, the snap ring from the bearing.

To remove the mainshaft rear bearing and speedometer gear, use the withdrawal tool listed in the Maintenance Equipment and extract the bearing and gear from the shaft.

Detach the 4th and 5th speed sliding dog clutch from the dog sleeve on the front of the mainshaft, then lift the mainshaft assembly through the top of the gearbox casing leaving the 1st speed gear wheel in the box; remove the 1st speed gear wheel.

**To dismantle the mainshaft assembly proceed as follows:—**

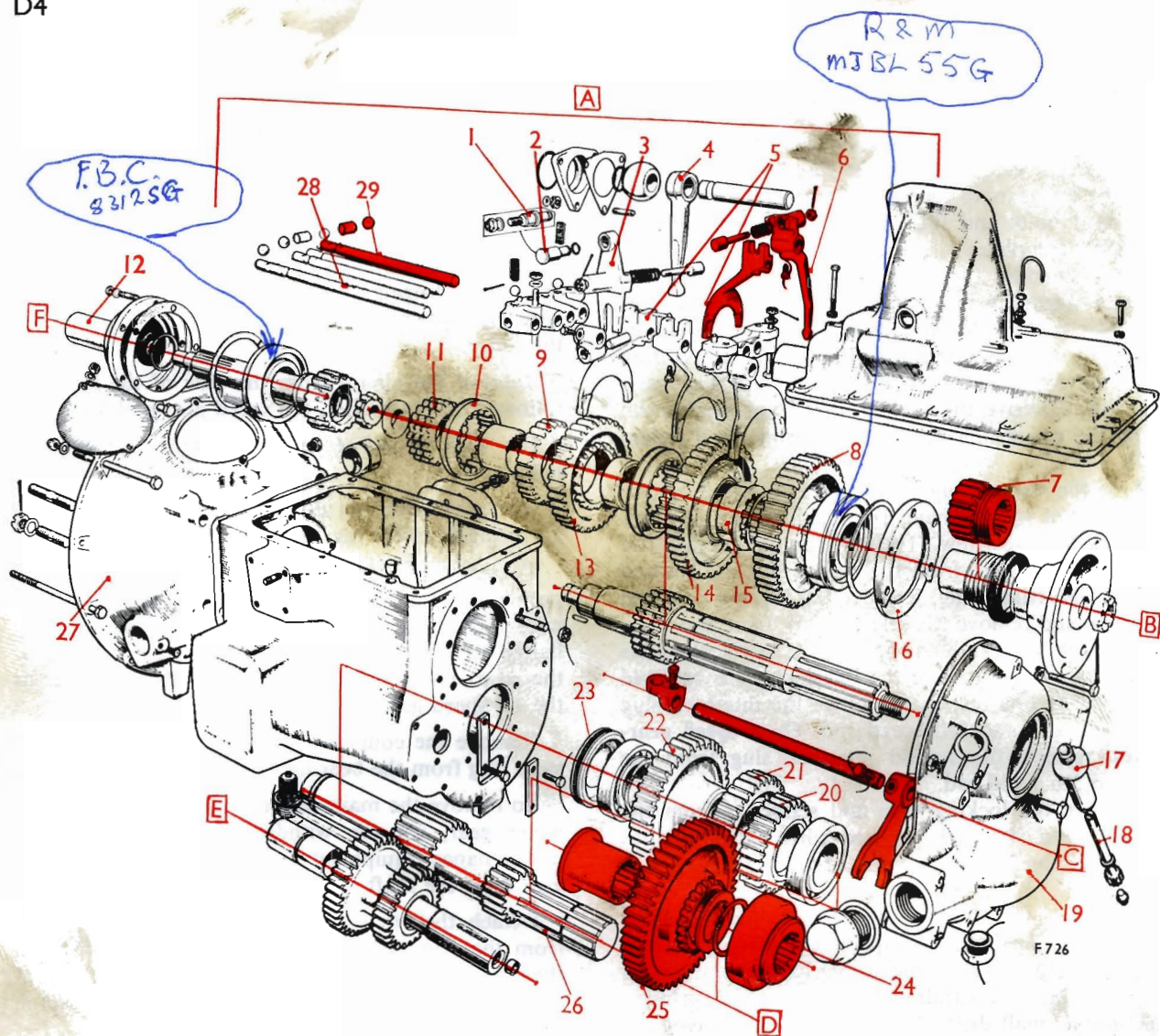
Remove the circlip from the splined portion of the shaft, grip the 2nd speed gear wheel, keeping the shaft vertical, then "bump" the rear end of the shaft against a piece of wood. The splined bush, 2nd speed gear wheel and 2nd and 3rd sliding dog clutch may then be removed; refer to "Note" on Page D6.

Remove the circlip from the spigot end of the mainshaft.

Stand the mainshaft in a press supported on its 3rd speed gear wheel with the spigot bearing at the top and press out the shaft. Remove the bearing inner race, washer, splined sleeve and the 4th and 3rd speed gear wheels and bushes, retaining the key for the splined sleeve.

### Primary Shaft

Remove the nuts securing the clutch withdrawal bearing sleeve to the front of the gearbox casing.



**Key to Letters and Numbers:—**

A. SELECTOR MECHANISM ASSEMBLY

B. MAINSHAFT ASSEMBLY

C. 6th SPEED RELAY SHAFT ASSEMBLY

D. LAYSHAFT ASSEMBLY

E. REVERSE AND IDLER GEAR ASSEMBLY

F. PRIMARY SHAFT ASSEMBLY

1. RELAY LINK PIVOT PIN (EARLY TYPE)
2. RELAY LINK PIVOT PIN (LATE TYPE)
3. RELAY LINK—1st SPEED AND REVERSE
4. GEAR STRIKING LEVER
5. SELECTOR FORK—4th AND 5th, OR ALTERNATIVE FORK FOR 6 SPEED GEARBOX
6. RELAY LEVER—6th SPEED SELECTOR MECHANISM
7. 6th SPEED GEAR (MAINSHAFT) AND SPEEDOMETER GEAR
8. 1st SPEED GEAR—MAINSHAFT
9. 4th SPEED GEAR—MAINSHAFT

10. 4th AND 5th SPEED SLIDING DOG CLUTCH—MAINSHAFT
11. SPLINED SLEEVE—4th AND 5th SPEED SLIDING DOG CLUTCH
12. CLUTCH WITHDRAWAL BEARING SLEEVE
13. 3rd SPEED GEAR—MAINSHAFT
14. 2nd SPEED GEAR—MAINSHAFT
15. SPLINED BUSH—2nd SPEED GEAR (See "NOTE"—on page D6 re 2nd speed gear)
16. BEARING KEEP RING
17. SPEEDOMETER ECCENTRIC BUSH
18. SPEEDOMETER DRIVEN GEAR

19. EXTENSION CASING
20. 3rd SPEED GEAR—LAYSHAFT
21. 4th SPEED GEAR—LAYSHAFT
22. PRIMARY GEAR—LAYSHAFT
23. FRONT BEARING DISTANCE PIECE
24. ENGAGEMENT DOG—6th SPEED
25. 6th SPEED GEAR—LAYSHAFT
26. LAYSHAFT
27. BELL HOUSING
28. SELECTOR ROD—1st SPEED AND REVERSE
29. SELECTOR ROD—6th SPEED

**Fig. D2 Exploded view of gearbox showing 6th speed components (when fitted) in red**

Cover the splines on the shaft to prevent damage to the lip type oil seal on the sleeve, and withdraw the sleeve from the shaft.

If the oil seal is in good condition, it should not be removed.

Using a lead hammer or a brass drift on the rear of the primary shaft, drive the shaft together with the bearing forward through the front of the gearbox casing.

Detach the bearing circlip from the shaft, and press the shaft out from the bearing.

### Reverse and Idler Gear

Remove the locking wire, the setbolts and keep plate from the rear end of the reverse idler gear shaft.

Withdraw the shaft by screwing the tool listed in the Maintenance Equipment into the withdrawal hole provided and remove the shaft. Remove the reverse and idler gear from the gearbox casing.

### Layshaft

Remove the locking wire, the setbolts and keep plates either side of the rear bearing.

Use a hammer and a soft drift to strike the rear end of the shaft in order to "bounce" the distance piece from the front bearing housing. Then, with the drift, drive the shaft **rearwards** until the rear bearing is free from its housing. Detach the outer race from the rear bearing.

Using the withdrawal tool listed in the Maintenance Equipment, draw off the inner race from the rear of the shaft.

Lift the front of the layshaft and remove the shaft through the top of the casing. Remove the outer race from the front layshaft bearing housing.

Extract the circlip between the inner race of the front bearing and the primary gear. Stand the layshaft in a press with the inner race at the top and press out the shaft. Remove the bearing, primary gear, 4th and 3rd speed gearwheels.

### To Assemble (see Figs. D1, D2, D3 and D4)

Wash thoroughly all components in clean paraffin and ensure that oilways and channels are free from obstruction.

Check that joint faces on the casing and cover are clean and free from burrs and traces of jointing compound.

Before fitting the gears to their respective shafts, examine the splines for burrs or damage; stone the splines if necessary and afterwards wash clean.

It is important that all circlips and snap rings, if removed, are renewed on assembly.

Assemble the gearbox in the order given:—

### Reverse and Idler Gear

Fit the plug into the reverse and idler gear shaft. Position the gear between the lugs of the casing with the small end of the gear towards the rear of the box. Insert the tapered end of the shaft into the case, keeping the lubricant hole on top, then drive in the shaft. Secure the shaft in position with the keep plate and secure with locking wire.

### Layshaft

Fit the layshaft key or keys.

Press the 3rd and 4th speed gear wheels and the primary gear on to the shaft and retain the assembly with a **new** circlip.

Insert the layshaft through the top of the box, passing the splined end of the shaft through the rear of the casing, and fit the rear roller bearing.

Using a suitable tube to cover both inner and outer races of the roller bearing, drive the bearing in flush with the rear face of the case. Fit the keep plates either side of the bearing and secure the setbolts with locking wire.

Support the front of the shaft, making sure that the spigot end is properly aligned with the bearing housing, then drive the bearing into the housing and hard against the shoulder of the shaft.

The distance piece should be fitted with a new rubber "O" ring, and then tapped into the bearing housing so that it is flush with the machined face on the front of the casing.

**Note.**—When the gearbox is provided with a 6th speed gear, fit the relay rod and lug; secure the lug with the setscrew and locking wire.

### Primary Shaft

**Renew** the snap ring, if removed, on the ball bearing outer race and press the bearing on to the primary shaft with the ring facing towards the splined end of the shaft; secure the bearing with a **new** circlip.

Fit the primary shaft using a sleeve and hammer to drive the bearing into the housing until the snap ring is against the casing.

Examine the oil seal in the clutch withdrawal bearing sleeve and, if necessary, renew. The lip of the seal must face outwards from the hub recess.

Fit a new joint on the flange of the bearing sleeve using a non-hardening jointing compound.

Cover the splines on the primary shaft with paper to protect the lips of the oil seal, then slide the bearing sleeve, hub first, on to the shaft. Pull the flange up evenly tightening the securing nuts in logical sequence.

### Mainshaft

Mount the mainshaft in a vertical position in a vice with the splined ~~end~~ of the shaft at the top. Fit

the 2nd speed gear wheel with the engagement teeth of the wheel against the shoulder of the shaft dog.

Smear the shaft splines with lubricant, then, on early gearboxes, slide the bush, flange side uppermost, on to the shaft so that the gear wheel is located by the bush. Drive the bush solidly on to the shaft using a suitable length of tube and secure the bush with a **new** circlip.

Remove the mainshaft from the vice and mount it in a horizontal position.

**Note:-** On **Later gearboxes**, fit the 2nd speed mainshaft bush with the chamfered end of the bush against the dog on the shaft, followed by the splined thrust washer; fit a **new** circlip.

Smear the 3rd and 4th speed gears with lubricant and slide them, 3rd speed gear first, on to the shaft so that the dog teeth of both gears are opposed to each other. Fit the bushes to the gears.

Fit the shaft key, then smear the inside diameter of the 4th and 5th speed dog sleeve with white lead to facilitate entry and press the dog on to the shaft. Fit the sliding dog clutch over the dog.

Fit the distance washer on the front of the shaft, with the chamfered bore of the washer towards the dog, followed by the spigot bearing. Use a suitable dolly to drive the bearing over the spigot and secure the assembly with a **new** circlip.

Rest the 1st speed gear wheel on top of the layshaft with the plain side of the gear in contact with the rear of the gearbox casing. Pass the mainshaft, rear end first through the 1st speed gear, and slide the shaft through the rear bearing housing.

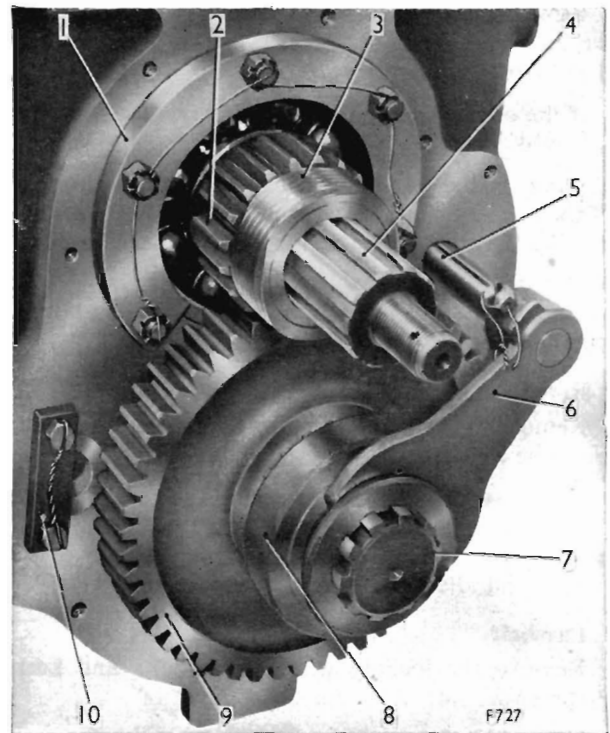
Align the front of the mainshaft with the rear of the primary shaft, then push the spigot bearing into the bearing recess.

Fit a **new** snap ring, if removed, into the groove on the rear ball bearing outer race and smear the bearing with oil. Slide the bearing over the shaft with the ring towards the end of the shaft. Start the bearing into the housing with a few light taps, then drive the bearing in squarely using a suitable tube over the shaft.

Assemble the bearing keep ring to the rear of the case with the recessed portion against the bearing and the cut-away section of the ring at the bottom. Fit the nuts to the keep ring and secure them with locking wire.

Lightly smear the shaft splines with grease and slide the speedometer gear over the shaft with the gear portion facing away from the bearing. Drive the gear home on to the shaft using a dolly and hammer. Finally, fit the coupling flange.

It should be noted that when a 6th speed gear is provided on the mainshaft, the speedometer gear is pressed on the rear of the 6th speed gear (see Fig. D3). The combined pinion and speedometer gears should



#### Key to Numbers:-

1. BEARING KEEP RING
2. 6th SPEED GEAR—MAINSHAFT
3. SPEEDOMETER GEAR
4. MAINSHAFT
5. RELAY ROD—6th SPEED
6. SELECTOR FORK—6th SPEED
7. LAYSHAFT
8. ENGAGEMENT DOG—6th SPEED
9. 6th SPEED GEAR—LAYSHAFT
10. KEEP PLATE—REVERSE AND IDLER GEAR SHAFT

Fig. D3 View of rear gearbox casing showing, when fitted, 6th speed gears

not be fitted until after the assembly of the layshaft 6th speed gear.

#### Layshaft 6th speed gear (when fitted)

With the mainshaft fitted, assemble the following to the rear of the layshaft:—

Fit the flanged side of the 6th speed gear bush against the layshaft rear bearing followed by the plain side of the 6th speed gear against the flange of the bush. Refit the washer and fit a **new** circlip.

Assemble the selector fork on the relay rod, then engage the fork with the engagement dog and slide the dog on to the layshaft.

Fit the combined 6th speed pinion gear and the speedometer gear to the rear of the mainshaft.

#### Extension Casing

Fit the thrust plug, if removed, in the boss at the base of the speedometer drive housing.

If the oil seal has been removed from the extension casing, fit a new seal into the housing with the lip of the seal facing towards the inside of the extension casing.

Fit a new paper joint on the extension casing, using a non-hardening jointing compound, and fit the extension casing to the rear of the gearbox. Tighten each of the securing nuts in logical sequence ensuring that the casing is pulled down evenly.

Fit the speedometer driven gear into the eccentric bush, noting that to retain the gear in position while fitting the bush, the spindle should be wedged at the slotted end.

The flange of the eccentric bush is provided with numbered position marks. When assembling, the numbered mark on the flange corresponding to the number of teeth on the driven gear, should coincide with the identification mark on the casing.

To ensure that a clearance exists between the eccentric bush flange and the speedometer drive housing, tap the eccentric bush fully home, then withdraw the eccentric bush approximately  $\frac{1}{16}$  in. (1.6 mm.) and tighten the clamp bolt; this will allow an adequate end float of the driven gear.

#### Bell Housing

Fit the bell housing, if removed, noting that it should be fitted **after the primary shaft bearing sleeve** in order to align the housing with the main casing. Tighten each of the securing nuts in a logical sequence.

#### Clutch Withdrawal Shaft

Insert the splined end of the shaft into the unbushed hole on the left side of the bell housing, slide the opposite end of the shaft into its seating and fit the collar and taper pin. The bush can then be fitted over the splined end of the shaft and driven into the bell housing.

Position the two toggle arms of the clutch withdrawal shaft vertically upwards, then slide the clutch withdrawal housing on to the primary shaft so that it engages the toggle arm pegs.

Connect the restraint spring between the housing and toggle arm and fit the lubrication pipe between the bearing housing and bell housing.

Fit the clutch operating lever to the withdrawal shaft so that it engages the same splines from which it was removed.

#### Striking Gear

Fit the striking lever from the inside of the selector cover.

Renew the rubber "O" rings on the spherical bearing and bearing cap.

Fit the spherical bearing and cap, checking that with the cap fully tightened the lever is free to move without undue tightness or play. If necessary, fit shims by selective assembly between the cap and casing (see Section 6).

#### Selector Mechanism (see Figs. D2, D4 and D5)

Assemble the fence plunger and spring to the 1st speed and reverse relay link. Tighten the plunger securing nut sufficiently to enable the end cap on the plunger to stand  $\frac{1}{16}$  in. (1.6 mm.) from the machined face on the lever, then pin in position.

Drive the pivot pin into the selector casing being careful to keep the pin true during entry. **On late gearboxes**, secure the pin with the washer and locknut.

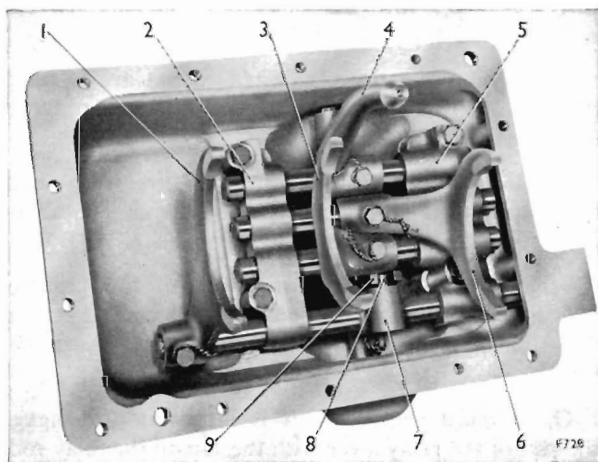
Fit the 1st speed and reverse relay link and secure with a **new** circlip.

The selector rods, forks and brackets should be assembled as a unit using the following method:—

Fit the 1st speed and reverse selector fork on to the plain end of the long selector rod, with the boss of the fork pointing **away** from the grooved end.

Fit the 2nd and 3rd, 4th and 5th selector forks on the short selector rods so that on one shaft the fork end is **nearest** the ball indent grooves and on the other, **furthest** from the grooves.

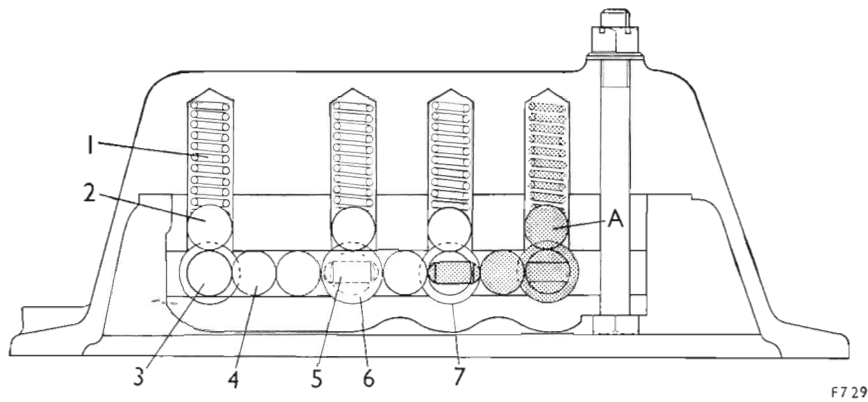
**On five speed gearboxes**, the 4th and 5th speed selector fork is fitted with a keep pin. The pin is riveted in position and provides a stop for the striking lever.



#### Key to Numbers:—

1. SELECTOR FORK AND ROD—1st SPEED AND REVERSE
2. REAR SELECTOR ROD BRACKET
3. SELECTOR FORK AND ROD—2nd AND 3rd SPEEDS
4. RELAY LEVER AND SELECTOR ROD—6th SPEED (WHEN FITTED)
5. FRONT SELECTOR ROD BRACKET
6. SELECTOR FORK AND ROD—4th AND 5th SPEEDS
7. STRIKING LUG
8. STRIKING PEG
9. RELAY LINK—1st SPEED AND REVERSE

Fig. D4 View of selector mechanism assembly



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**Key to Letter and Numbers:—**

A. SHADED AREA SHOWING 6th SPEED MECHANISM (WHEN FITTED)

1. INDENT SPRING

2. INDENT BALL

3. 1st SPEED AND REVERSE SELECTOR ROD

4. INTERLOCK BALL

5. INTERLOCK SLUG

6. 2nd AND 3rd SPEED SELECTOR ROD

7. 4th AND 5th SPEED SELECTOR ROD

**Fig. D5 Section through gear selector interlock mechanism for 5 and 6 speed gearboxes**

When the 6th speed relay lever is fitted, the striking arm of the lever must be positioned furthest from the indent grooves.

Fit the setscrews to each of the forks, making sure that the setscrew enters the locating hole in the shaft, and secure with locking wire.

Slide the 1st and reverse speed selector rod through the rear selector rod bracket as shown in Fig. D4.

Press the striking peg into the striking lug (see Fig. D4), then fit the lug so that it is positioned on the shaft opposite to the indent grooves. Fit the setscrew and secure the lug with locking wire.

Slide the 2nd and 3rd, 4th and 5th, and 6th speed (when fitted) selector rods into the rear bracket (see Fig. D4).

Lift the assembly into a horizontal position with the 1st and reverse speed rod on the bench.

Fill the holes in the front selector bracket with grease and slide the bracket on the 1st and reverse rod (as shown in Fig. D4), until the drilling through the bracket is in line with the interlock groove on the rod. Keep the other rods clear of the bracket.

Insert two interlock balls into the top of the bracket, slide the slug into the hole in the interlock groove on the 2nd and 3rd speed rod and "centre" the groove with the drilling in the bracket.

Fit the third interlock ball into the top of the bracket and "centre" the interlock groove on the 4th and 5th speed rod with the drilling in the bracket.

When the selector mechanism is fitted with a 6th speed selector fork, fit the fence plunger, spring and nut to the relay lever. Tighten the nut sufficiently to enable the end cap on the plunger to stand proud  $\frac{1}{16}$  in. (1.6 mm.) from the machined face on the lever, then pin in position.

Fit the second slug into the hole in the interlock groove on the 4th and 5th speed rod, and centre the interlock groove with the drilling in the bracket.

Insert the fourth interlock ball into the top of the bracket and "centre" the interlock groove on the 6th speed selector rod with the drilling in the bracket.

**For both 5 or 6 speed gearboxes proceed as follows:—**

Insert the indent balls into the front bracket and the ball springs into the selector cover; there should be a ball and spring to each selector rod.

Check that the dowels (when fitted) are in each bracket, then fit the securing bolts and assembly on to the selector cover.

Tighten the nuts on the front bracket first, in order to compress the springs; keep the assembly in alignment with the casing whilst tightening the bolts.

When fitting the selector cover to the gearbox casing, check that the sliding dogs are centralized on the mainshaft in order to line up with the selector forks.

On 6 speed gearboxes, it is important to engage the end of the relay lever with the lug on the relay rod.

## Section 2

## CHANGE-SPEED BOX

Goods Type Chassis; Refer to Section 8 for Passenger Type Chassis

(See Fig. D6)

**To Remove**

Remove the bonnet or tilt the cab.

Remove the clamp bolts securing the muff coupling to the swivel lever shaft and remove the coupling from the shaft.

Draw up the gaiter on the change-speed lever, remove the nuts securing the seating cap and detach the lever and cap from the box by easing the lever upwards and outwards. Retain any shims found under the cap.

Cut the locking wire (when fitted) and/or remove the setbolts securing the change-speed box to the engine and free the box from its seating and manoeuvre the box away.

**To Dismantle**

As the change-speed lever, seating cap and gaiter have already been removed, continue dismantling by detaching the gaiter from the change-speed lever and separating the lever from the seating cap. The fulcrum pin should be pushed out from the spherical ball on the lever.

Remove the nuts securing the swivel lever bearing cap and free the swivel lever from the box. Slide the spherical bearing and cap from the shaft together with any shims that may be fitted, then detach if necessary the rubber "O" rings from the bearing and cap.

**To Assemble**

Reverse the procedure for dismantling observing the following points:—

Wash all parts in clean paraffin and examine them for signs of wear; renew where necessary.

Fit **new** rubber "O" rings inside the spherical bearing and end cap.

Insert the swivel end of the swivel lever shaft into the box and fit the shims, if necessary, between the bearing cap and casing. Check that with the cap fully tightened, the swivel lever is free to move without undue tightness or play (see Section 6).

Fit the fulcrum pin in the ball of the change speed lever. Take the seating cap for the lever and fasten the gaiter to it with a clip. Slide the lever through the gaiter and seating cap so that the fulcrum pin engages in the cap.

Do not fit the change-speed lever until the box is fitted to the engine (see under "To Fit").

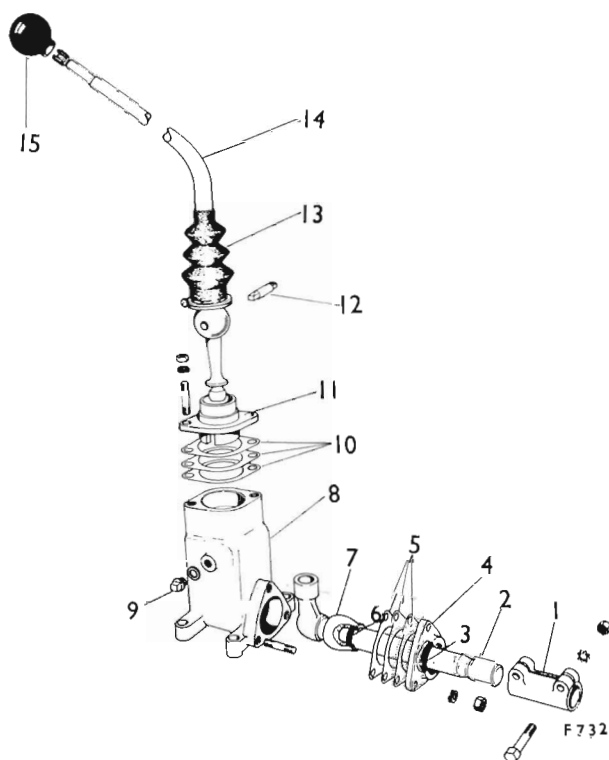
**To Fit**

From underneath the chassis, return the change-speed box to its seating.

Tighten the setbolts securing the change-speed box to the engine and (when fitted), secure the setbolts with locking wire, then fill the box with oil up to the level plug. Refit the level plug.

Fit the change-speed lever into the box so that its end engages the swivel lever. Fit the seating cap and check that with the cap fully tightened, the lever is free to move without undue tightness or play. If necessary, fit shims between the seating cap and casing (see Section 6).

When the change-speed box is completely assembled, fit the muff coupling (see Section 3, "To Adjust").

**Key to Numbers:—**

1. MUFF COUPLING
2. SWIVEL LEVER SHAFT
3. RUBBER "O" RING—BEARING CAP
4. BEARING CAP—SWIVEL LEVER
5. SHIMS—SWIVEL LEVER BEARING CAP/CHANGE SPEED BOX
6. RUBBER "O" RING—SPHERICAL BEARING
7. SPHERICAL BEARING
8. CASING—CHANGE SPEED BOX
9. OIL LEVEL PLUG
10. SHIMS—CHANGE SPEED LEVER SEATING CAP/CHANGE SPEED BOX
11. SEATING CAP
12. FULCRUM PIN
13. RUBBER GAITER
14. HAND LEVER
15. HAND LEVER BALL

Fig. D6 Exploded view of typical change-speed box

## Section 3 CHANGE-SPEED LEVER AND SELECTOR MECHANISM

Goods Type Chassis; Refer to Section 9 for Passenger Type Chassis

### To Adjust (see Fig. D6)

**Note.**—Adjustment should only be necessary if the change-speed box, selector mechanism, or gearbox has been removed.

Fit the muff coupling to the swivel and gear striking lever shafts. The grooved ring on the shafts must be lined up with the bolt holes in the coupling. Fit the rear clamp bolt to the coupling and tighten securely.

To ensure that the striking lever ball tip is positioned correctly, the following procedure must be adopted:—

Rotate the muff coupling, as far as it will go, towards the left-hand side of the vehicle; hold in position.

This method ensures that the ball tip on **5 speed gearboxes**, is in contact with the keep pin on the 4th and 5th selector fork, or alternatively on **6 speed gearboxes**, is in contact with the fence plunger on the relay lever.

Keep the muff coupling fully rotated towards the left-hand side of the vehicle, then move the change-speed lever sideways, as far as it will go, towards the

right-hand side of the vehicle. Tighten the front coupling clamp bolt.

On chassis with the change speed box fitted to the engine casing, two muff couplings and a cranked coupling shaft are used, therefore the method of adjustment is slightly different.

Whilst the general procedure is substantially the same as already described, ensure that when adjustment is being made, both of the clamp bolts for the coupling shaft **only** are loose until the adjustment is finalised; then tighten both bolts.

On **6 speed gearboxes**, the same procedure should be adopted except that having moved the change-speed lever as far as it will go towards the right-hand side of the vehicle, the lever should be moved back again approximately  $\frac{1}{4}$  in. (6.35 mm.) towards the left-hand side of the vehicle. Tighten the front coupling clamp bolt when in position.

Make certain that nothing has moved whilst bolting up, by moving the change-speed lever into each gear position in turn and feeling for the respective selector ball to drop into its indent.

## Section 4 PRIMARY SHAFT PILOT BEARING

### To Remove

Remove the gearbox from the vehicle (see Part A).

Remove the clutch (see Part C).

Remove from the rear end of the engine crankshaft the pilot bearing retaining circlip.

Using the withdrawal tool listed in the Maintenance Equipment, enter its back-nut sideways through the pilot bearing bore and the nut will fall on end behind the bearing.

Screw the withdrawal tool centre screw into the back-nut, hold it with a spanner and tighten the withdrawal nut. The pilot bearing will then be drawn out (see Fig. D7).

### To Fit

Pack the recess in the end of the crankshaft with grease.

Tap the bearing into position, making sure that the side of the bearing with the grease retaining ring is **away** from the crankshaft; then fit a **new** circlip.



Fig. D7 Method of removing primary shaft pilot bearing

## Section 5 POWER TAKE-OFF UNITS

### To Remove

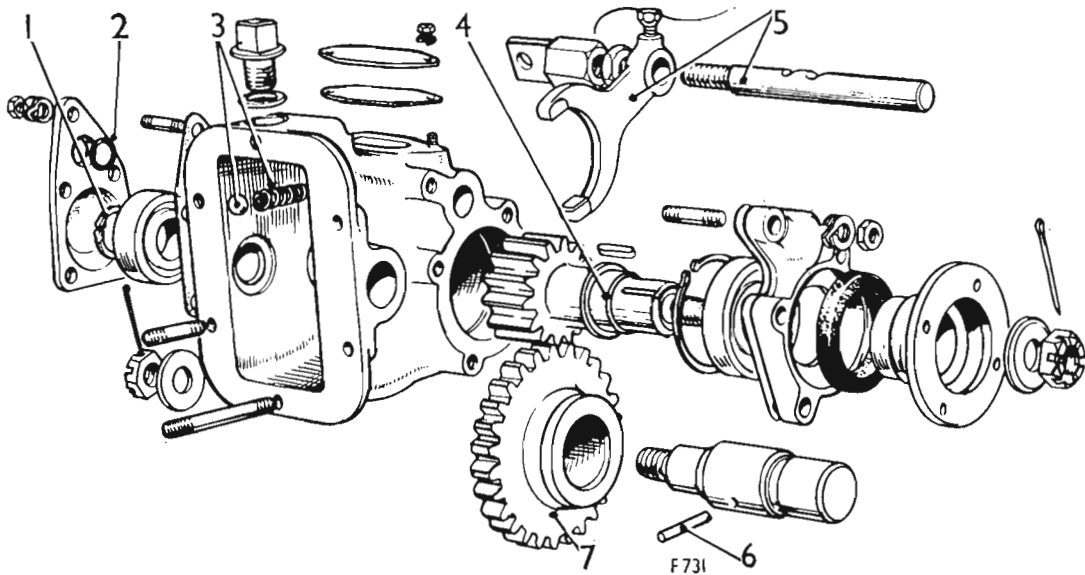
**Normal Duty and Full Torque Units** (see Figs. D8 and D9).

Drain the oil from the gearbox.

Disconnect the control linkage from the striking

mechanism, and the coupling flange on the output shaft.

Remove the nuts securing the power take-off to the gearbox and remove the unit. Retain the shims



**Key to Numbers:—**

- |                                       |                           |                                    |
|---------------------------------------|---------------------------|------------------------------------|
| 1. CIRCLIP—OUTPUT SHAFT FRONT BEARING | 3. INDENT BALL AND SPRING | 6. LOCATING PIN—IDLER GEAR SHAFT   |
| 2. OIL SEAL—FRONT COVER               | 4. OUTPUT SHAFT           | 7. IDLER GEAR (See "Note" in text) |
|                                       | 5. STRIKING FORK AND ROD  |                                    |

**Fig. D8 Exploded view of typical normal duty power take-off**

between the gearbox and unit casing noting their thickness and number.

Fit a temporary cover over the opening in the gearbox casing to prevent the ingress of foreign matter.

**Idler Gear—Full Torque Unit (see Fig. D9).**

**Early and Late Types**

The low speed power take-off unit is driven by an idler gear located inside the gearbox casing and driven by the layshaft constant mesh gear. Should it be necessary to remove the idler gear and shaft from the gearbox proceed as follows:—

Remove the gearbox (see Part A).

Remove the clutch withdrawal housing and bell housing from the gearbox (see Section 1).

Remove the locking wire, setbolts and keep plate from the front end of the idler shaft.

Support the idler gear assembly inside the casing and withdraw the shaft by screwing the tool listed in the Maintenance Equipment into the withdrawal hole provided. Carefully remove the idler gear assembly and distance piece(s) from the casing and then detach the inner race of the **roller** bearing from the idler gear.

**Early Type**

Remove both internal circlips retaining the outer race of the roller bearing and the ball bearing, then press the bearing assembly from the gear.

**Late Type**

Remove the internal circlip from the plain end (rear) of the idler gear assembly.

Using a soft metal drift, drive the **ball** bearing assembly out of the rear end of the hub.

Remove the internal circlip from the centre of the hub and withdraw the large distance piece.

Finally, drive the outer race of the **roller** bearing out of the hub.

**To Dismantle**

**Normal Duty Unit (see Fig. D8)**

Remove the securing nut and washer from the output flange, and with the withdrawal tool listed in the Maintenance Equipment, draw off the flange. Retain the key.

Unscrew the nuts securing the front and rear covers and remove the covers from the unit casing. The oil seal in the rear cover should only be removed if damaged or worn.

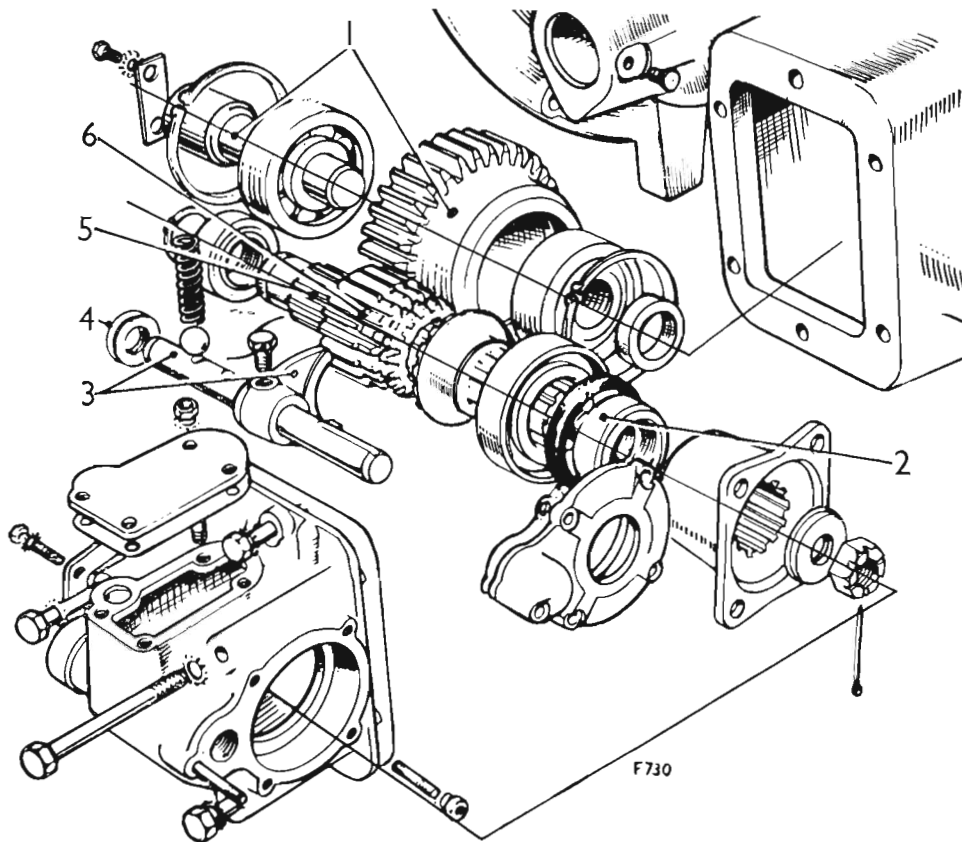
Remove the nut securing the idler gear shaft. Use a suitable brass drift to drive out the shaft towards the rear of the casing and detach the idler gear through the open side of the casing. Remove the locating pin from the shaft if necessary.

**Note:—**On certain vehicles the **idler gear** is mounted on a double row of **bearing rollers** and not as shown in Fig. D8.

To dismantle this type of idler gear mounting, proceed as follows:—

Remove the split pin, nut and washer from the end of the idler shaft.

Using a soft metal drift, drive the shaft through the hub of the gear and the rear aperture in the casing.



**Key to Numbers:—**

- |   |                          |                                 |
|---|--------------------------|---------------------------------|
| 1. IDLER GEAR AND SHAFT ASSEMBLY<br>(EARLY TYPE) (For Late Type see "Text") | 3. STRIKING ROD AND FORK | 5. OUTPUT SHAFT                 |
| 2. COMBINED DISTANCE PIECE AND<br>RUBBING RING                              | 4. OIL SEAL—STRIKING ROD | 6. SLIDING GEAR—OUTPUT<br>SHAFT |

**Fig. D9 Exploded view of typical full torque power take-off**

Remove the internal circlips from the hub of the idler gear and withdraw the spacers and rollers.

**On both types,** drive out the output shaft and ball bearing towards the rear of the casing sufficiently to remove the ball bearing from its housing. The shaft will be prevented from removal by the internal circlip.

Use a suitable extractor to withdraw the ball bearing from the shaft and remove the internal circlip; the output shaft can then be removed.

Remove the bearing circlip from the spigot bearing end of the shaft and press off the inner race of the roller bearing. Remove the outer race of the roller bearing from the front of the casing.

Unscrew the nuts securing the striking cover and detach the cover.

Remove the locking wire and setscrew from the striking fork. Withdraw the striking rod, taking care to restrain the spring loaded indent ball, and remove the fork, ball and spring.

**Full Torque Unit (see Fig. D9)**

Remove the securing nut and washer from the

output flange and, with the tool listed in the Maintenance Equipment, draw off the flange.

Unscrew the nuts securing the front and rear covers and remove them from the casing. The oil seal in the rear cover, unless damaged or worn, should be left undisturbed.

Detach the combined distance piece/oil seal rubbing ring from the rear of the output shaft.

Using a suitable brass drift, drive the output shaft towards the rear of the casing and remove the shaft, sliding gear and bearings.

Remove the bearing circlip from the spigot end of the shaft and press off the inner race of the roller bearing and the sliding gear. Remove the outer race of the roller bearing from the inside of the casing by using a suitable dolly.

Unscrew the nuts securing the top cover to the unit casing and remove the cover, spring and indent ball.

Remove the locking wire and setscrew from the striking fork, then drive out the rod from the fork end. The striking rod oil seal, unless worn or dam-

aged, should not be removed from the casing end cover.

### To Assemble

Wash all parts thoroughly in clean paraffin and allow to dry.

Check that the joint faces on the casing and covers are clean and free from all traces of jointing compound.

Examine the gears, bearings and seals for wear and renew if necessary.

### Normal Duty Unit (see Fig. D8)

Fit the outer race of the roller bearing flush with the machined face of the front casing. Renew the sealing on the front cover and fit the cover on the casing.

Press the inner race of the roller bearing on to the spigot end of the shaft and secure with a **new** circlip.

Insert the spigot end of the output shaft into the casing so that the inner race is located in the outer race of the bearing. Fit a **new** internal circlip inside the bearing housing, and with a suitable dolly, drive in the bearing so that it is located against the circlip.

Fit the oil seal in the rear cover with the lip of the seal facing inwards.

When the spring, indent ball and rod have been fitted, assemble the fork into the casing locating the fork on the striking rod. Fit the locking screw and rewire.

Assemble the idler gear and shaft into the casing, followed by the output flange and washer. Tighten the securing nuts on both input and output shafts and split pin in position.

### Note:

When the **idler gear** is mounted on bearing rollers, proceed as follows:—

Fit a new internal circlip to one end of the idler gear hub. Apply a smear of grease to each of the spacers and bearing rollers.

Insert one of the two thinner spacers in the hub and locate it against the circlip.

Position the gear wheel on the bench, circlip downwards. Pack the lower half of the hub circumference with rollers and fit the thick spacer. Repeat this operation on the other half of the hub and fit the remaining thin spacer.

Secure the assembly by fitting the circlip.

Position the idler gear inside the casing so that the selector groove is towards the rear. Enter the idler shaft through the boss at the rear of the casing and into the hub of the idler gear. Drive the shaft through the hub and the boss in the front of the casing so that the locating pin in the rear of the shaft is correctly located in its slot.

Fit the washer, nut and split pin to secure the idler shaft and check that the idler gear moves smoothly and freely along the shaft.

### Full Torque Unit (see Fig. D9)

Reverse the procedure for dismantling noting the following:—

When new oil seals are required, fit the striking rod oil seal into the casing so that the flat rubber portion of the seal is inserted first. Fit the rear cover oil seal, with the metal portion of the seal at the bottom of the cover recess. Use a suitable dolly to drive the seal fully into the recess.

Examine the output shaft splines for burrs or damage; stone the splines if necessary and afterwards wash in clean paraffin.

Fit the sliding gear on the output shaft so that the teeth on the gear are nearest the spigot end of the shaft.

Do not, at this stage, fit the top cover with indent ball and spring until after the unit has been correctly shimmed and fitted to the gearbox casing (see under "To Fit").

### To Fit

#### Idler Gear—Full Torque Unit (see Fig. D9)

Fit the idler gear and shaft (if removed) to the gearbox in the reverse order to their removal noting the following:—

#### Early Type

Before pressing the bearing assembly into the idler gear, fit a **new** bearing circlip on the plain side of the gear and press the ball bearing in against the circlip. The outer race of the roller bearing should be pressed in, with the lip of the bearing **inwards** and then secured with a **new** circlip. Fit the roller assembly.

#### Late Type

Fit a new internal circlip in the groove in the centre of the idler gear hub.

Press the **ball** bearing into the plain end (rear) of the hub so that it locates against the circlip in the centre and then fit a new circlip in the outer groove.

Position the idler gear on the bench, front end uppermost.

Enter the large diameter distance piece into the hub and locate it against the circlip.

Press the outer race of the **roller** bearing into the front end of the hub, with the lip of the race located on the distance piece.

Position the **narrow** distance piece **centrally** on the inner race of the **ball** bearing and fit the **roller** assembly into the outer race ensuring to keep the narrow distance piece correctly located between the two bearing assemblies and aligned with the bores.

**Both Types**

With the teeth of the idler gear assembly towards the front of the gearbox, insert the idler gear assembly through the opening in the side of the gearbox casing and locate the distance piece against the ball bearing.

With both gear and distance piece supported, insert the shaft into the gearbox casing and, with a lead hammer, drive the shaft fully home. Fit the keep plate and secure the setbolts with locking wire.

Refit the bell housing, clutch withdrawal housing (see Section 1) and refit the gearbox (see Part A).

**Both Types of Units** (see Figs. D8 and D9)

Fit the unit in the reverse order to its removal noting the following:—

Ensure that the joint faces of the gearbox and power take-off casing are clean and free from burrs.

Fit a new paper joint to the power take-off casing with a non-hardening jointing compound.

When fitting the power take-off casing to the

gearbox, fit the shims by selective assembly and check the backlash between the gears as follows:—

**On Normal Duty Units**, remove the inspection plug from the top of the casing to obtain access to the idler gear. The amount of backlash permissible between the layshaft and the idler gear should be approximately 0.003 to 0.005 in. (0.076 to 0.13 mm.). Adjust the shims accordingly and afterwards refit the inspection plug and washer. Extra shimming up to a maximum of 0.010 in. (0.25 mm.) backlash is permissible if the gears are noisy.

**On Full Torque Units**, remove the top cover from the casing (if fitted at this stage), and engage the sliding gear with the idler shaft gear. The amount of backlash permissible between these gears should be approximately 0.003 to 0.008 in. (0.076 to 0.20 mm.). Adjust the shims accordingly, and afterwards fit the indent ball, spring and cover.

When the power take-off unit is fitted, fill the gearbox with fresh oil to the level of the filler plug.

**Section 6****DIMENSIONS OF SHIMS AVAILABLE**

Alternative shims listed hereunder are supplied to enable correct clearances to be obtained during assembly.

Part	Thickness
Striking Lever Bearing Cap/Selector Casing .. .. .	0.002 in. (0.05 mm.) 0.006 in. (0.15 mm.) 0.010 in. (0.25 mm.)
Swivel Lever Bearing Cap/Change-speed Box .. .. .	0.002 in. (0.05 mm.) 0.006 in. (0.15 mm.) 0.010 in. (0.25 mm.)
Change-Speed Lever Seating Cap/Change-speed Box .. .. .	0.002 in. (0.05 mm.) 0.006 in. (0.15 mm.) 0.010 in. (0.25 mm.)
Normal Duty Power Take-off Casing/Gearbox .. .. .	0.002 in. (0.05 mm.) 0.004 in. (0.10 mm.) 0.010 in. (0.25 mm.)
Full Torque Power Take-off Casing/Gearbox .. .. .	0.002 in. (0.05 mm.) 0.003 in. (0.07 mm.) 0.007 in. (0.17 mm.)
Change-speed Lever Bearing Top Seating/Bottom Seating .. .. .	0.010 in. (0.25 mm.) 0.014 in. (0.36 mm.) 0.018 in. (0.46 mm.)

**Section 7****SPEEDOMETER DRIVEN GEARS**

The following table shows the number of teeth on the speedometer driven gear for various tyre sizes and axle ratios. Used in conjunction with a speedometer head having a constant of 800 revolutions per mile or 500 revolutions per kilometre.

## Rear Axle Ratio

4.08 : 1  
4.70 : 1  
5.22 : 1  
5.87 : 1  
6.27 : 1  
6.28 : 1  
6.92 : 1  
7.84 : 1

Number of  
teeth on  
Speedometer  
Driven  
Gear

9.00-20

Tyre Size  
10.00-20

11.00-20

11	10	10
12	12	12
14	13	13
15	15	14
16	15	15
16	15	15
18	17	17
20	20	19

## Section 8

## CHANGE-SPEED BOX

## Passenger Type Chassis

(see Fig. D10)

## To Remove

Remove the bolts and disconnect the coupling flange from the change-speed box.

Remove the bolts securing the change-speed box to the bracket on the chassis frame side member. Lower the assembly and remove from the vehicle.

## To Dismantle

Remove the nuts securing the top cover and lift out the change-speed lever complete.

Remove the shims and bottom spherical bearing seating from the change-speed box.

Remove the retaining circlip and remove the collar, control spring and spherical bearing from the change-speed lever.

Slacken the dust cover retaining clip and remove the top spherical bearing seating from the change-speed lever.

Remove the dust cover if necessary.

Remove the nut and washer securing the coupling flange to the change-speed swivel lever.

Tap the coupling off its taper and retain the key.

Remove the nuts and washers securing the rear cover to the change-speed box and slide the cover off the swivel lever.

Remove the swivel lever through the rear of the change-speed box.

Remove the spherical bearing from the centre of the swivel lever if necessary.

## To Assemble

Reverse the procedure given for dismantling noting the following points:—

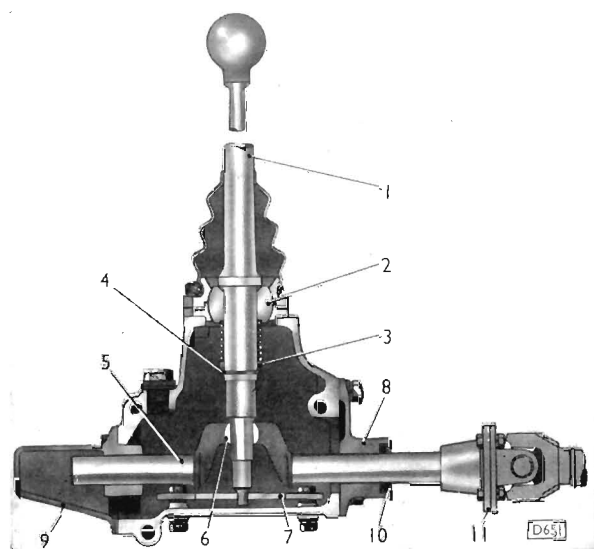
If a new oil seal is to be fitted in the rear cover of the change-speed box, it must be fitted with its lip facing **inwards**.

Vary the thickness of shims between the top and bottom spherical bearing seatings, if necessary, to allow the bearing to be held between the seatings without undue tightness or play.

(For the thickness of shims available see Section 6).

## To Fit

Reverse the removal procedure, and check the adjustment of the relay shafts as instructed in Section 9.



## Key to Numbers:—

1. CHANGE-SPEED LEVER
2. SPHERICAL BEARING
3. COLLAR
4. CIRCLIP
5. ACTUATING SHAFT

6. SPHERICAL BEARING
7. REVERSE STOP PLATE (NOT APPLICABLE)
8. FRONT COVER
9. REAR COVER
10. OIL SEAL
11. COUPLING FLANGE

Fig. D10 Arrangement of typical change-speed box—  
Passenger type chassis

## Section 9

## CHANGE-SPEED RELAY SHAFTS—

## Passenger Type Chassis

**To Remove**

**Note.**—Shafts should be removed and fitted complete with the spherical bearings.

The sequence of removal is—1st relay shaft; 3rd relay shaft; 2nd relay shaft.

**1st Shaft.** Loosen the clips securing the dust covers; push back the covers. Free the front end by removing the nuts, washers and bolts from the flange.

Take out the grub screw at the rear end and release the collar.

Slacken the clamping bolts of the adjusting flange at the front end of the 2nd relay shaft. Unscrew the 1st shaft until it is free.

**3rd Shaft.** Loosen the clips securing the dust covers; push back the covers. Free the rear end by removing the nuts, washers and bolts from the flange.

Take out the grub screw at the front end and release the collar.

Slacken the clamping bolts of the adjusting flange at the rear end of the 2nd relay shaft. Unscrew the 3rd shaft until it is free.

**2nd Shaft.** After the 1st and 3rd shafts have been detached as described above, the 2nd relay shaft is free.

**Spherical Bearings.** If necessary the spherical bearing mounted on the guide bracket can be removed by unscrewing the nuts from the bolts which secure the bearing cups to the bracket.

The other spherical bearing can be removed by unscrewing the nuts and bolts, and taking away the washers and distance pieces from their mounting.

**To Fit and Adjust**

If the spherical bearings have been removed, clean all parts thoroughly.

Grease each bearing and place it in the cups.

Mount the forward bearing on the guide bracket, securing it with the bolts, washers and nuts.

Mount the rear bearing on the rear side of the third cross-member of the chassis frame, using the bolts, distance pieces, washers and nuts.

With the gearbox in the neutral position, **lift** the change-speed lever on top of the gate in the near vertical position; the slightest touch on the lever should cause it to slip back to its original position; then adjust the relay shaft as follows:—

Screw the threaded ends of the 1st and 3rd relay shafts into the adjusting flanges on the 2nd shaft. Tighten the clamp bolts on the adjusting flanges at the front end of only the 2nd shaft.

Secure the collars on the 1st and 3rd shafts with the grub screws.

Attach the flange on the end of the 1st shaft to the swivel lever coupling of the change-speed selector box using the bolts, washers and nuts.

Offer the plain flange of the 3rd shaft to the gearbox universal coupling and secure temporarily with the bolts, washers and nuts.

Adjustment should now be made on the rear adjusting flange of the 2nd shaft by screwing or unscrewing the 3rd shaft as required.

Tighten the bolts securing the 3rd shaft to the gearbox universal coupling. Then tighten finally the clamp bolts of the adjusting flange on the rear end of the 2nd shaft.

Pull the dust cover over the connections and fasten with clips.

Finally, test for the engagement of each gear, this will be indicated by the “feel” of the interlock balls engaging their respective grooves on the selector rod.

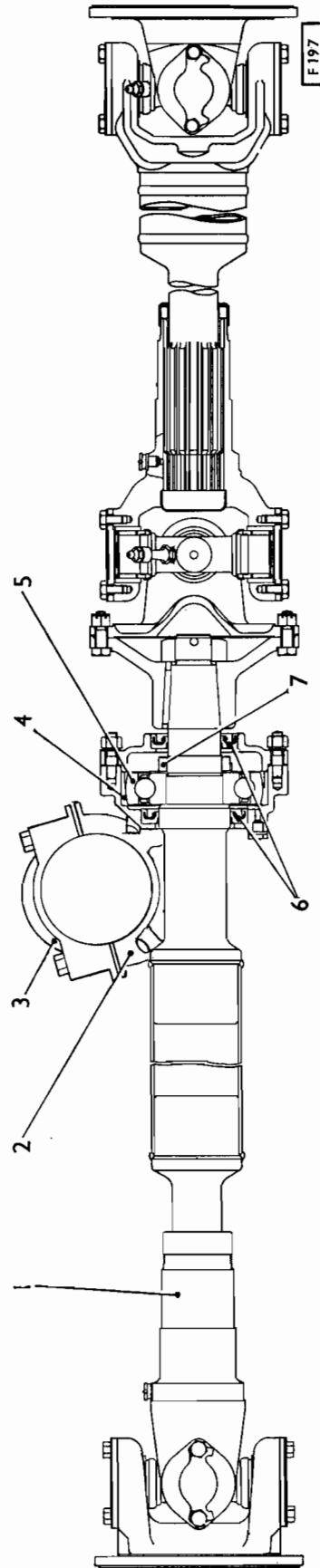
# PART E 36

## PROPELLER SHAFTS

E 36

### CONTENTS

	<i>Section</i>
Propeller Shafts :— .. .. .	1
To Remove and to Dismantle	
To Assemble and to Fit	



**Key to Numbers:—**

- 1. SLIDING END
- 2. BEARING BRACKET

- 3. BEARING BRACKET CAP
- 4. SPHERICAL RING
- 5. INTERMEDIATE BEARING

- 6. SEALS
- 7. BEARING RETAINING NUT

**Fig. E1** Arrangement of typical propeller shafts with intermediate bearing (passenger chassis)

## Section 1

## PROPELLER SHAFTS

(See Figs. E1, E4 and E5)

### To Remove

**Front and Rear Shafts** (*Gearboxes mounted independently of the engine*)

Disconnect both joint flanges from their yoke flanges, collapse the sliding end along the splines and remove the shaft complete with joints.

### Intermediate Shafts

Disconnect the lubricant supply pipe (when fitted) from the intermediate bearing bracket.

Disconnect the joint flange from the yoke flange at the front end of the shaft, and also the flanges behind the intermediate bearing; unbolt the intermediate bearing bracket(s) from the frame crossmember, collapse the sliding joint and remove the shaft complete with universal joint and intermediate bearing bracket assembly.

Certain front shafts supported by a resiliently mounted centre bearing, have no sliding end.

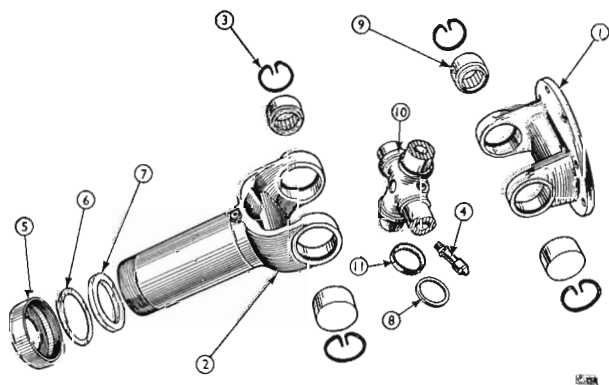
**Front and Centre Shafts** (*Gearboxes of unit construction with the engine*)

Disconnect the lubricant supply pipe (if fitted) from the intermediate bearing bracket.

Disconnect the joint flange from the yoke flange at the front end of the front shaft, and also the flanges behind the intermediate bearing; unbolt the intermediate bearing bracket(s) from the frame crossmember taking care to retain the shims fitted between the bracket(s) and crossmember, collapse the sliding joint and remove the shaft complete with universal joint and intermediate bearing bracket assembly.

### Rear and Inter-axle Shafts

Disconnect both joint flanges from their yoke flanges, collapse the sliding end along the splines and remove the shaft complete with joints.



#### Key to Numbers:—

- |  |                          |
|--|--------------------------|
| 1. YOKE FLANGE                           | 6. STEEL WASHER          |
| 2. YOKE (SLIDING END)                    | 7. FELT WASHER           |
| 3. CIRCLIP                               | 8. STAR PIECE GASKET     |
| 4. LUBRICATOR FOR NEEDLE ROLLER BEARINGS | 9. NEEDLE ROLLER BEARING |
| 5. DUST CAP                              | 10. STAR PIECE           |
|  | 11. GASKET RETAINER      |

Fig. E2 Exploded view of compressor drive shaft universal joint (when fitted)

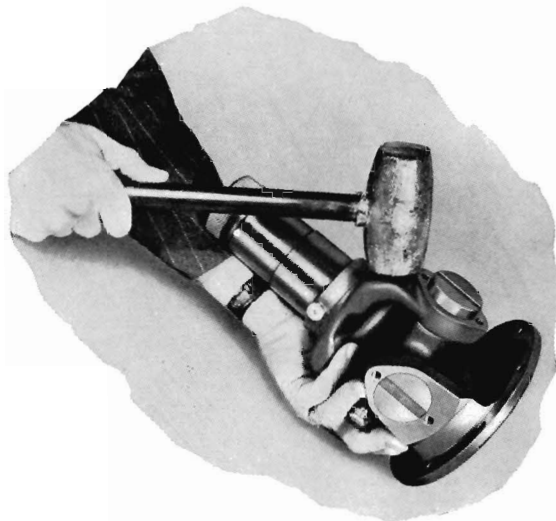


Fig. E3 Method of removing needle roller bearings from universal joint

### To Remove (Bridgmaster Vehicles Without Transmission Transfer Box)

#### Front Shaft (Long and Short Wheelbase Vehicles)

Remove the securing bolts from the shaft intermediate bearing bracket taking care to retain the shims fitted between the bracket(s) and crossmember.

Disconnect the joint flanges at both ends and collapse the sliding joint end of the rear (or intermediate) connecting shaft.

Secure the front and rear shafts (or intermediate shaft) to some convenient part of the vehicle and then collapse each sliding end.

Remove the retaining nut from the rear joint flange and remove the flange, using, if necessary, the withdrawal tool listed in the Maintenance Equipment.

Move the intermediate bearing bracket as far as possible to the left-hand side of the vehicle, lower the front end of the shaft to clear the forward flange and remove the shaft diagonally forward from the bearing bracket.

The bearing bracket can now be removed if necessary.

#### Centre Shaft (Long Wheelbase Vehicles Only)

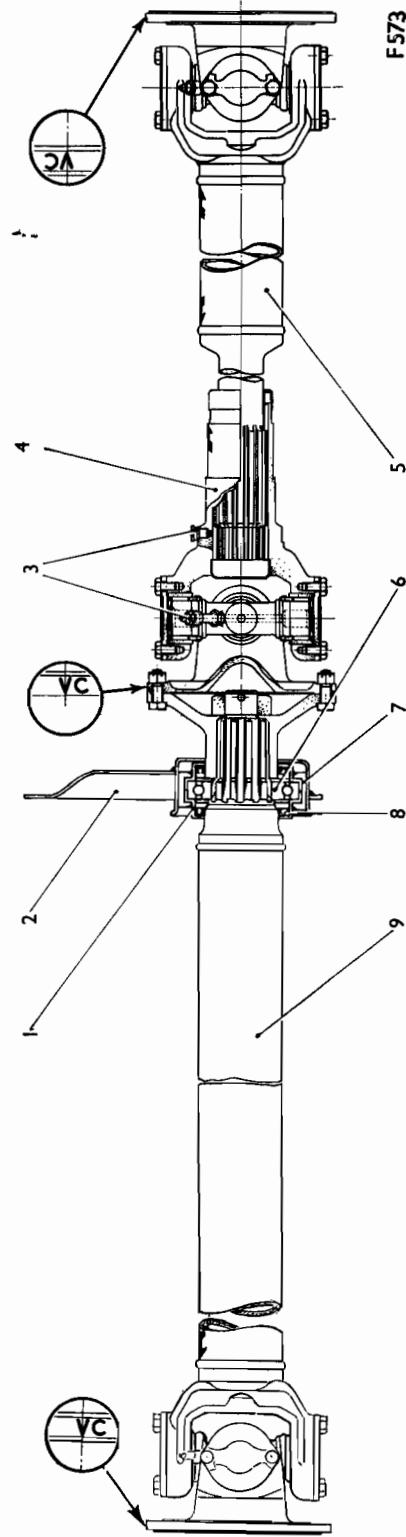
See procedure for the Front Shaft.

#### Rear Shaft (Long and Short Wheelbase Vehicles)

Remove the stiffening channel which is bolted underneath the body structure crossmember which passes underneath the shaft.

Disconnect each joint flange.

Collapse the sliding joint end and remove the shaft by drawing it towards the front end of the vehicle.



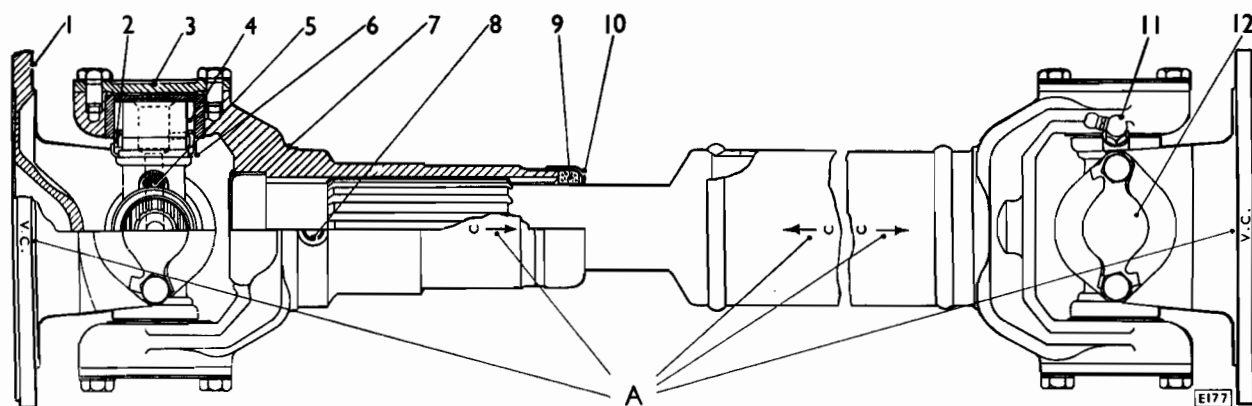
**Key to Numbers:—**

- 1. SEAL AND BEARING HOUSING
- 2. INTERMEDIATE BEARING BRACKET

- 3. LUBRICATORS
- 4. SLIDING END
- 5. REAR CARDAN SHAFT

- 6. INTERMEDIATE BEARING
- 7. RESILIENT MOUNTING
- 8. SEAL
- 9. FRONT CARDAN SHAFT

**Fig. E4 Arrangement of a typical propeller shaft with resiliently mounted intermediate bearing (goods chassis and certain passenger chassis)**



**Key to Letter and Numbers:—**

A. ARROWS ON SLIDING END AND TUBE MUST BE IN LINE WITH THE MARKS "V.C." ON THE YOKE FLANGE (SHOWN 90° OUT OF POSITION)

1. YOKE FLANGE
2. STAR PIECE GASKET
3. BEARING COVER
4. NEEDLE ROLLER BEARING
5. LUBRICATOR
6. GASKET RETAINER

7. SLIDING END SHAFT YOKE
8. LUBRICATOR
9. FELT AND STEEL WASHERS
10. DUST CAP
11. LUBRICATOR
12. LOCK STRAP

**Fig. E5 Section through a typical propeller shaft**

**To Remove (Bridgmaster Vehicles With Transmission Transfer Box)**

**Rear Propeller Shaft**

Place chocks under the road wheels and release the handbrake.

Remove brake pipe bracket from the rear suspension subframe crossmember.

Remove the bolts securing the subframe crossmember.

Remove the crossmember by moving the left-hand side forward and the right-hand side to the rear.

Remove the stiffening plate from the fourth body structure crossmember.

Disconnect the flanges at each end of the shaft.

Remove the dust cap from the splined end and withdraw the shaft out backwards from the vehicle.

**Front Propeller Shaft**

First remove the rear propeller shaft as previously described.

Remove the rear flange retaining nut and draw off the flange from the end of the shaft, using, if necessary, the tool listed in the Maintenance Equipment.

Remove the retaining bolts and draw off the intermediate bearing assembly.

Disconnect the flange from the transfer box output shaft.

Remove the sliding end and draw the shaft out backwards from the vehicle.

**To Dismantle**

Before dismantling the inertia ring type damper (when fitted), mark the inner and outer rings in relation to each other to ensure correct re-assembly.

**Front, Rear and (when fitted) Inter-axle Shafts**

Unscrew the dust cap; remove the split felt or cork washer and steel washer from the shaft yoke at the sliding end of the shaft. Pull the shaft yoke off its splines and dismantle each universal joint in turn as follows:—

Knock down the tabs of the lock straps, then remove the fixing screws, lock straps and bearing covers from the yoke ears.

When a compressor drive shaft is fitted, remove the circlips which retain the needle roller bearings in the yoke ears (see Fig. E2).

Tap the ears of the yoke downwards with a lead hammer, so that the needle roller bearing is knocked out of the roller bore (see Fig. E3).

Repeat the operation for the opposite bearing.

Support the two exposed star piece journals on lead blocks (to protect the ground surfaces) and tap the ears of the yoke flange to remove the needle roller bearing. Turn the assembly over and repeat the operation to remove the other needle roller bearing.

**Front and Centre Shafts**

Dismantle the universal joint (see *To Dismantle*), then dismantle the intermediate bearing assembly as follows:—

Remove the split pins and nuts from the special bolts retaining the bearing housing to the support bracket and remove the bolts.

Unscrew the nut, draw off the joint flange by means of the tool listed in the Maintenance Equipment and remove the key.

Remove the bearing cover with its seal (when fitted), and unscrew the bearing retaining nut from the shaft, then tap the shaft through the bearing. The ball

bearing and second seal can now be tapped free from the housing.

On an intermediate bearing assembly with a resiliently mounted bearing, press out the complete inner assembly from the bracket and prise off the resilient mounting (*see Figs. E4 and E6*).

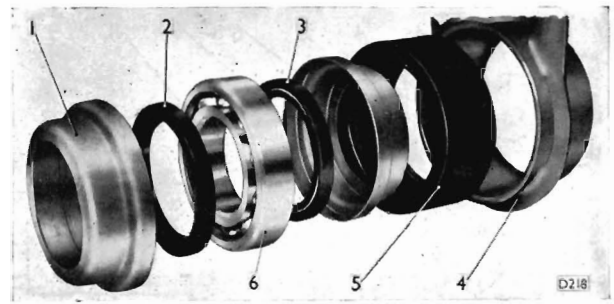
### To Assemble

Fit the parts in the reverse order to their removal, noting the following points:—

Renew any parts that are worn, and fill the joints with lubricant. It is advisable to fit new gaskets on the star piece, the shoulders of which should be shel-laced prior to fitting, to ensure a good seal; make sure that the channels in the star piece are filled with lubricant and that the needle roller bearings are also about one-third full. If any difficulty is encountered when assembling the rollers in the housings, smear the wall of the housing with grease.

Insert the journal of the star piece in the yoke flange holes and, using a lead hammer, tap one of the needle roller bearings into position, so that the slot in the end of the bearings is in line with the two tapped holes in the yoke flange ear.

Repeat this operation for the opposite bearing.



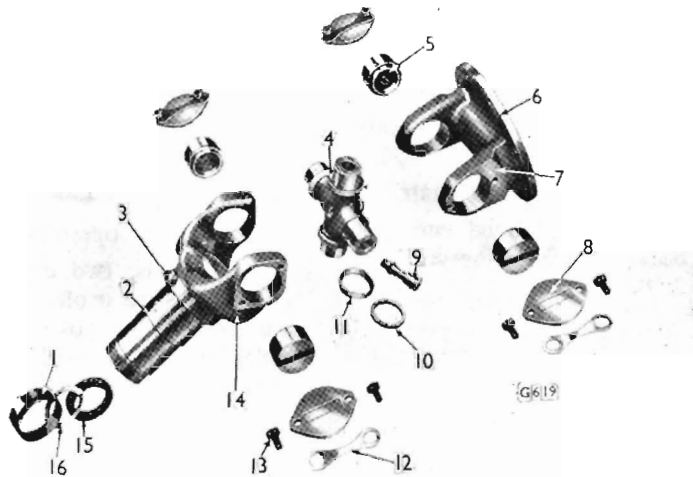
### Key to Numbers:—

- |                                     |                                 |
|-------------------------------------|---------------------------------|
| 1. SEAL AND BEARING HOUSING         | 4. INTERMEDIATE BEARING BRACKET |
| 2. SEAL (NOTE POSITION FOR FITTING) | 5. RESILIENT MOUNTING           |
| 3. SEAL (NOTE POSITION FOR FITTING) | 6. BALL BEARING                 |

**Fig. E6** Exploded view of typical intermediate bearing (goods chassis and certain passenger chassis)

If the joints appear to bind when assembled, tap the ears **lightly** with a lead hammer, to relieve any pressure on the end of the star piece bearings.

When assembling a sliding end joint see that the mark "V.C." on the yoke flange is in line with the arrow on the shaft yoke.



### Key to Numbers:—

- |                          |                       |
|--------------------------|-----------------------|
| 1. DUST CAP              | 9. LUBRICATOR         |
| 2. SPLINED SLIDING END   | 10. STAR PIECE GASKET |
| 3. LUBRICATOR            | 11. GASKET RETAINER   |
| 4. STAR PIECE            | 12. LOCK STRAP        |
| 5. NEEDLE ROLLER BEARING | 13. SECURING SCREW    |
| 6. YOKE FLANGE           | 14. YOKE EAR          |
| 7. FLANGE EAR            | 15. FELT WASHER       |
| 8. BEARING COVER         | 16. STEEL WASHER      |

**Fig. E7** Parts of a typical universal joint

When assembling sliding end joints on the shaft splines, smear the splines liberally with grease and **see that the marks "V.C." on each yoke flange and the arrow on the shaft are in line.**

Compression of the felt or cork washer, sufficient to ensure a good seal, should be possible by hand tightening of the dust cap.

On assembly with a **resiliently mounted and grease packed** ball bearing, the lips of the seals must both **point towards each other**, and on those lubricated through an **external lubricator**, the lips must both **point away from each other.**

#### NOTE:—

**Independently mounted gearbox centre shafts and unit construction gearbox front and centre shafts** have an arrow at the intermediate bearing end pointing towards the **rear** of the chassis. This arrow is for manufacturing purposes only and should be disregarded when fitting universal joints, which should be lined up with the arrow at the **front** end of the shaft and which points to the **front** of the chassis.

#### To Fit

Fit the shafts to the chassis by reversing the procedure for their removal noting the following points:—

When refitting the intermediate bearing bracket, note that on no account must there be a gap between the bracket and crossmember before tightening the fixing bolts; refit, as necessary, the shims between this gap.

Examine the spigots of the flanges and the yokes to ensure that they are clean and quite free from burrs that might prevent satisfactory fitting.

The sliding end of all shafts should be fitted towards the front of the chassis.

The markings on the various shafts must be fitted in the following relationship (*see note in To Assemble*).

#### **Independently Mounted and Unit Mounted Gearboxes with Three Shafts**

Markings on rear shaft to be at right angles to markings on centre shaft.

#### **Gearboxes of Unit Construction with Two Shafts Mercury and Marshal chassis**

All trunnions must be **in line** with each other (*see Fig. E4*).

#### **Other chassis**

Markings on rear shaft to be at right angles to markings on front shaft.

#### **Two-axle Drive Chassis**

On two-axle drive chassis in which a third differential is **not** incorporated, the "lining-up" mark "V.C." on the inter-axle propeller shaft flanges should be, as nearly as possible, **in line** with similar markings on the flanges of the rear axle input propeller shaft.

These instructions should be observed to ensure smooth running of the shafts and to prevent vibration due to uneven angular velocity.

## NOTES

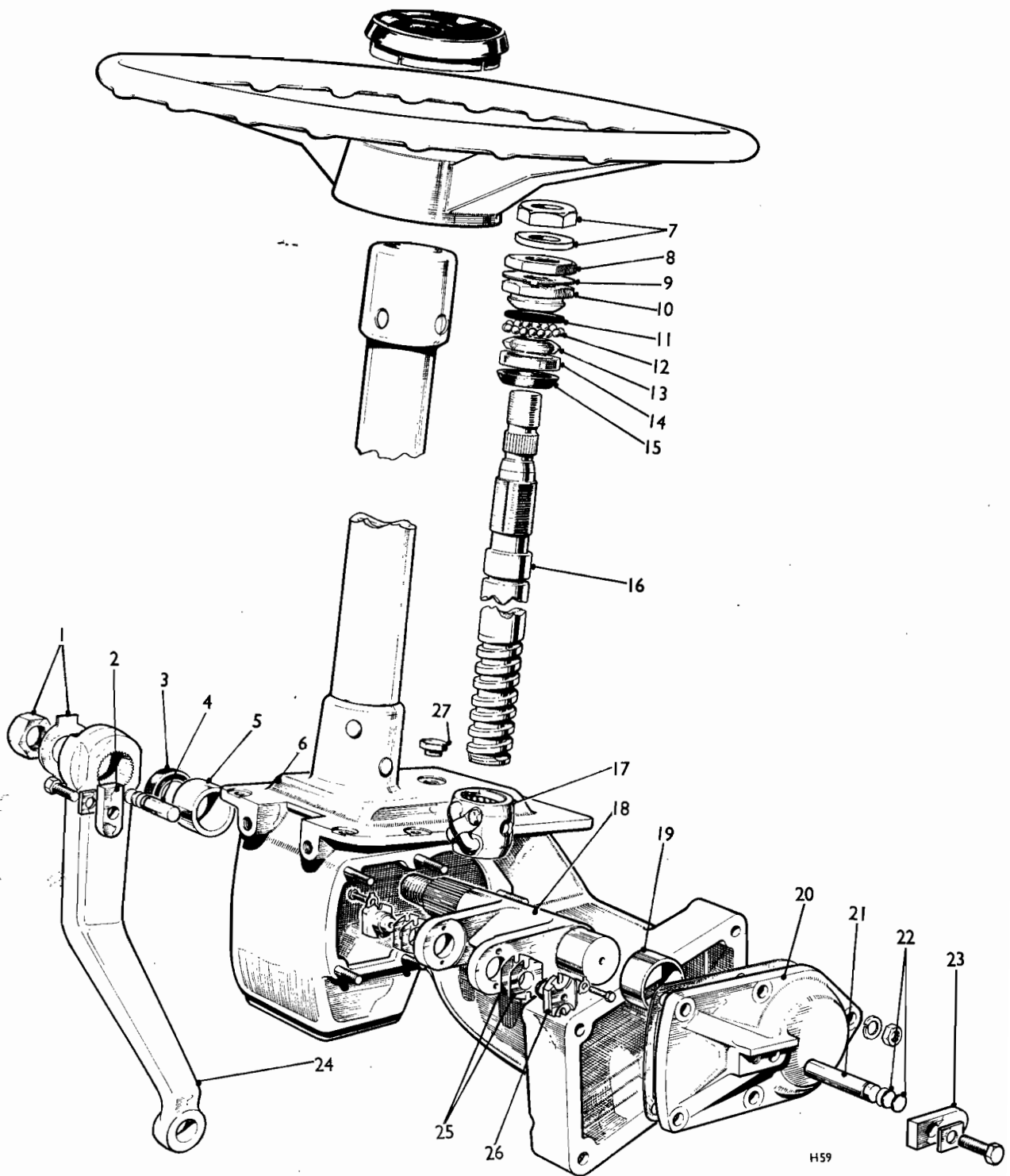
# PART F32

## STEERING GEAR

(Manual and Power Assisted)

### CONTENTS

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To Dismantle and Assemble	
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**Key to Numbers:—**

1. SECURING NUT AND TABWASHER—DROP ARM
2. RETAINING PLATE—CENTRALIZING ADJUSTER
3. OIL SEAL—ROCKER SHAFT
4. CENTRALIZING ADJUSTER—STEERING BOX
5. BUSH—ROCKER SHAFT
6. STEERING BOX
7. SECURING NUT AND (WHEN FITTED) WASHER—STEERING WHEEL
8. LOCKNUT—ADJUSTABLE BEARING RACE

9. TABWASHER—ADJUSTABLE BEARING RACE (WHEN FITTED)
10. ADJUSTABLE BEARING RACE
11. "O" RING—ADJUSTABLE BEARING RACE
12. BALL BEARINGS
13. FLOATING BEARING RACE
14. FIXED BEARING RACE
15. OIL SEAL
16. STEERING SHAFT
17. STEERING NUT
18. ROCKER SHAFT

19. BUSH—ROCKER SHAFT
20. COVER PLATE—STEERING BOX
21. CENTRALIZING ADJUSTER AND "O" RING—COVER PLATE
22. SHIMS—CENTRALIZING ADJUSTER
23. RETAINING PLATE—CENTRALIZING ADJUSTER
24. DROP ARM
25. SHIMS—STEERING NUT BALL PEG
26. BALL PEG—STEERING NUT
27. OIL FILLER PLUG

**Fig. F1 Exploded view of steering gear**

## Section 1

## STEERING GEAR

(See Fig. F1)

### To Dismantle

Remove the unit from the vehicle (*see Part A*).

Clamp the unit in a vice with the cover plate uppermost. Remove the securing nuts and detach the cover plate and gasket from the steering box. Drain off the oil.

Re-position the unit with the column vertical. Remove the locknut, tabwasher, adjustable bearing race and ball bearings from the steering shaft. Unscrew the shaft from the steering nut and withdraw it complete with the floating bearing race, fixed bearing race and oil seal.

Cover the serrations on the rocker shaft to prevent damage to the oil seal and withdraw the steering nut and rocker shaft assembly from the steering box. To detach the nut from the rocker shaft, release the tabwashers, unscrew the ball peg retaining set bolts and withdraw the ball pegs and shims from the rocker shaft.

Remove the steel balls from the steering nut.

**Do not remove the centralizing adjusters from the box or cover plate unless a new rocker shaft is to be fitted (*see under "To Adjust"*).**

Similarly, do not remove the rocker shaft bush and oil seal from the steering box unless they show signs of wear or damage and are to be renewed.

### To Assemble

Wash all parts in clean paraffin and allow to dry.

Examine the rocker shaft bushes and oil seal for wear; if the oil seal is to be renewed, fit the seal with its lip facing **inwards** towards the rocker shaft bush.

Check the top bearing housing, bearing races, steering shaft thread and steering nut ball track for indentation and wear.

Check for wear on the spherical ball peg ends and in the ball peg sockets in the steering nut.

Examine the rubber "O" ring on the adjustable bearing race and the bearing oil seal for deterioration. If the centralizing adjusters have been removed, check the "O" rings for deterioration.

Renew any parts found defective.

Note that the steering nut is renewable only as a complete assembly comprising the nut, transfer tube, transfer tube retaining bolts and tabwasher.

If there are no new parts to be fitted, pack the steel balls in the steering nut with sufficient grease to retain them. Position the nut in the rocker shaft arms **with the transfer tube facing away from the rocker shaft**. Insert the ball pegs with an equal amount of shims on either side. Fit and tighten the ball peg retaining bolts, locking them with **new** tabwashers. Adjust if necessary (*see under "To Adjust"*).

Position the nut and rocker shaft assembly in the steering box.

Fit the top bearing oil seal, fixed bearing race and floating bearing race on to the steering shaft and enter the shaft through the bearing housing on the steering column. Engage the end of the shaft in the thread of the steering nut, **taking care to avoid winding the steel balls out of the nut**.

Pack the top bearing housing with grease and insert the steel balls followed by the adjustable ball race complete with "O" ring, the tabwasher and locknut. Adjust the bearing (*see under "To Adjust"*).

Fit the gasket and cover plate, tightening the securing nuts evenly in succession.

**Note.**—To avoid unnecessary removal of adjacent parts, it will be found more convenient to fit the drop arm **after** the steering unit has been fitted to the vehicle (*see Part A*).

Fill the steering box with oil.

### To Adjust

#### Steering Shaft Top Bearing

Check the end play between the fixed bearing race and the floating bearing race by moving the drop arm and noting the amount of backlash.

To adjust, release the tabwasher, slacken the locknut and turn the adjustable bearing race until the bearing is free with no end float. Apply "Loctite" to the thread and tighten the locknut, holding the bearing race with the spanner listed in the Maintenance Equipment; recheck the end float, then tighten the locknut to a torque loading of 125 lb. ft. (17.3 kg. m.) and lock the tabwasher.

**Note.**—On certain chassis, no tabwasher is fitted. A more substantial locknut is fitted and should be tightened to a torque loading of 150 lb. ft. (20.7 kg. m.). **Do not overtighten** as this will cause indentation of the races and consequent bearing failure.

**Note.**—If a new rocker shaft is to be fitted, it will be necessary to check the shaft centralizing adjusters and the steering nut as follows:—

#### Steering Nut

Adjustment on the steering nut is effected by shims fitted between the ball pegs and the rocker shaft. To adjust, remove the cover plate, release the tabwashers from each ball peg retaining bolt, unscrew the retaining bolts and remove the ball pegs. Add or remove shims as necessary to leave the nut free but with no backlash. For thickness of shims available see Section 7.

### Rocker Shaft

The adjusters enable the steering shaft to be positioned at right angles to the rocker shaft and parallel to the cover plate face.

To check this positioning, turn the steering shaft until the nut is in the centre of the box, i.e. the nut has moved half its travel on the steering shaft (*see Part A*). Measure with a depth gauge from the cover plate face to the outside diameter of the steering shaft on **both sides** of the steering nut. These measurements should be the same to within 0.015 in. (0.38 mm.) If they are not, release the tabwasher and remove the bolt and plate retaining the centralizing adjuster in the steering box. Add or remove shims as necessary behind the adjuster until the limit of 0.015 in. (0.38 mm.) is obtained when the plate is refitted.

Remove the bolt, tabwasher, retaining plate and shims from the cover plate and refit the gasket and cover plate to the steering box, tightening down evenly.

Push the centralizing adjuster into the cover plate until it contacts the arm of the rocker shaft, then fit sufficient shims until the top shim is level with the retaining plate boss (*see Section 7 for shims available*).

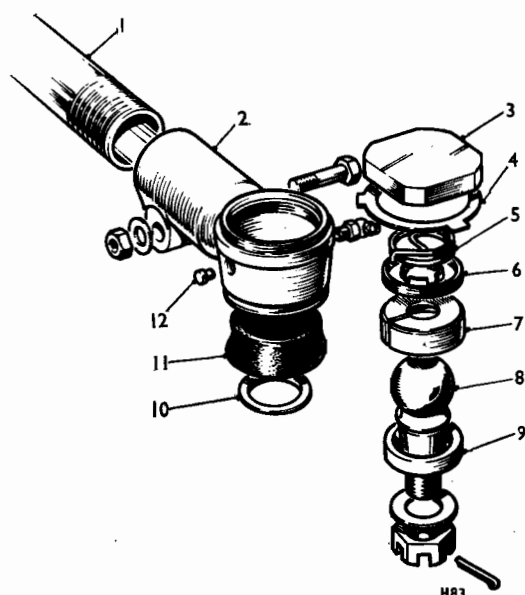
Fit the retaining plate, tabwasher and bolt.

Recheck for any end float on the rocker shaft; if there is more than 0.004 in. (0.10 mm.) end float, fit extra shims on the cover plate adjuster until a minimum of end float is obtained.

## Section 2

### DRAG LINK SOCKET ASSEMBLIES

(*See Fig. F2*)



#### Key to Numbers:—

1. DRAG LINK OR TRACK ROD TUBE
2. SOCKET
3. TOP COVER
4. TAB WASHER
5. LOCKING SPRING
6. ADJUSTMENT CAP
7. BALL PIN CUP—UPPER
8. BALL PIN
9. BALL PIN CUP—LOWER
10. GAITER RETAINING RING
11. RUBBER GAITER
12. LOCATING DOWEL

Fig. F2 Exploded view of drag link socket

#### To Dismantle

Mark the position of the socket in relation to the drag link tube, slacken the socket clamp bolt and unscrew the socket assembly from the tube.

**Note.**—The drag link tube on manual steering has sockets on both ends which are provided with left and right-hand threads to facilitate adjustment, whilst

the drag link tube on power steering has one plain end and one socket end.

Release the rubber gaiter, complete with the retaining ring, from the ball pin taper.

Clamp the socket assembly in a vice, unlock the tabwasher and remove the top cover.

Unscrew and remove the adjustment cap complete with spring.

Remove the upper ball pin cup and lift out the ball pin.

If necessary, press out or withdraw the lower ball pin cup.

#### To Assemble

Press in the lower ball pin cup, if removed.

Insert the ball pin and upper ball pin cup, locating the split in the cup on the dowel in the socket.

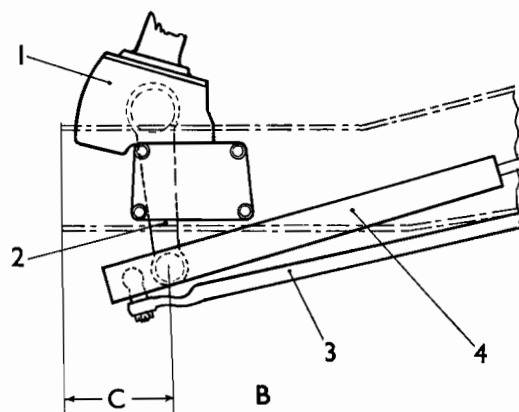
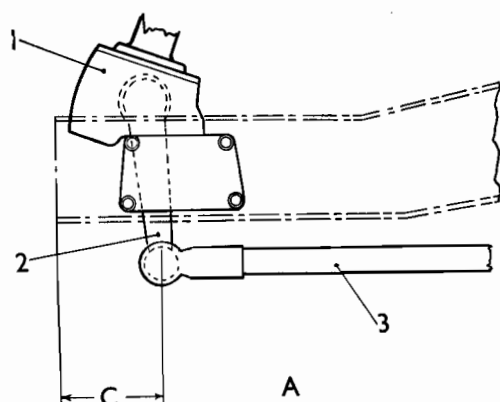
Screw in the adjustment cap to lightly load the ball pin. Check that the ball pin moves freely under finger pressure. Fit the spring, locating the straight inner leg across the cap slots and the short outer leg in the nearest hole in the socket housing, to provide light spring load on the adjustment cap.

**Note:**—Do not stretch the spring unduly to line up with a locating hole.

Fit the top cover with a new tabwasher, locating the small tab in the indent in the socket. Tighten the cover down fully and lock it with the tabwasher to the socket.

Fit the retaining ring **inside** the gaiter and fit the assembly to the ball pin taper. Locate the gaiter bead in the socket groove.

Screw the socket on to the drag link tube, aligning the marks made on dismantling, then fit the clamp bolt.



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**Key to Letters and Numbers:—**

- A. MANUAL STEERING  
 B. POWER ASSISTED STEERING  
 C. DIMENSIONS  $6\frac{1}{4}$  in. (170 mm.) FOR VTG CHASSIS  
 DIMENSIONS  $6\frac{1}{4}$  in. (174.6 mm.) FOR TG CHASSIS

1. STEERING BOX  
 2. DROP ARM  
 3. DRAG LINK  
 4. HYDRAULIC POWER CYLINDER

**Fig. F3 Drop arm settings****Section 3****DROP ARM AND DRAG LINK***(See Fig. F3)***To Fit**

For fitting of the drop arm refer to Part A.

**To Adjust**

On power assisted steering, connect up the drop arm with the rear "manual" ball pin on the hydraulic cylinder (see Fig. F3).

On manual and power assisted vehicles, adjust the track rod so that the front road wheels are parallel and in the straight ahead position (see Part G).

Turn the steering wheel in the appropriate direction to obtain dimension "C" (measured between the front of the frame and the centre of the ball pin hole in the drop arm).

**Manual Steering**

Adjust the drag link so that the ball pins enter the tapered holes in the drop arm and swivel lever without disturbing either part. Tighten the clamp bolts in the drag link sockets.

**Power Assisted Steering**

Connect up the plain end of the drag link with the front "power" ball pin on the hydraulic cylinder (see Fig. F3).

Adjust the socket end of the drag link to connect up with the front axle swivel lever. Tighten the socket clamp bolt.

After adjustment, check the setting of the steering stop setscrews (see Section 4).

**Section 4****STEERING STOP SETSCREWS****To Set****Manual Steering**

Turn the front wheels on to the left-hand lock until there is  $\frac{3}{8}$  in. (9.5 mm.) clearance between the tyre and the drag link, then measure the distance between the tyre and the frame.

Set the left-hand stop setscrew against the axle beam.

Turn the wheels on to the right-hand lock to give the same distance between the tyre and frame as on the left-hand lock.

Set the right-hand stop setscrew against the axle beam.

**Both locks must be limited by the axle stops and not the stops in the steering box.**

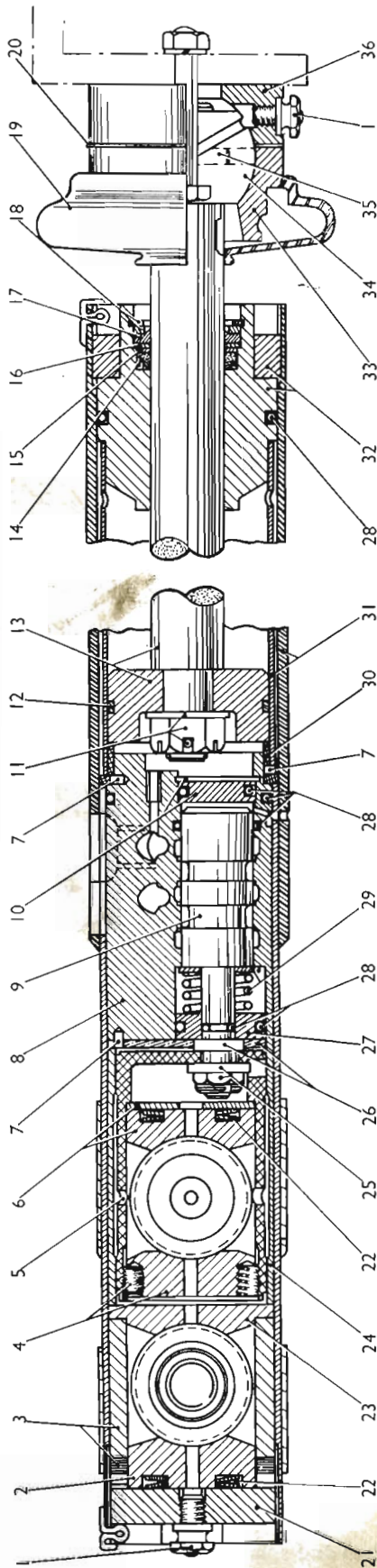
If there is insufficient travel of the drop arm to ensure this condition, the locks must be reduced by adjusting the axle stops an equal amount.

**Power Assisted Steering**

Turn the wheels to both locks in turn until the piston "bottoms" in the hydraulic cylinder and adjust the respective stop setscrews so that they are  $\frac{1}{16}$  in. (1.59 mm.) clear of the axle beam.

Check that there is adequate running clearance when on left-hand lock between the offside wheel and tyre and the drag link. If there is not sufficient clearance, reduce the locks by adjusting the axle stops an equal amount.

Finally, tighten and split pin all ball pins.



### Key to Numbers:—

- |   |   |
|---|---|
| 1. LUBRICATOR                                 | 21. END COVER                                     |
| 2. OUTER BALL CUP (POWER)                     | 22. DISC SPRINGS                                  |
| 3. LOCK RING AND SPACER                       | 23. INNER BALL CUP (POWER)                        |
| 4. OUTER BALL CUP AND GRUB SCREW (MANUAL)     | 24. LOCATING SLEEVE                               |
| 5. OPERATING SLEEVE                           | 25. LOCKNUT AND WASHER                            |
| 6. INNER BALL CUP AND BACK-ING PLATE (MANUAL) | 26. SPACER AND COLLAR                             |
| 7. LOCATING PIN                               | 27. REACTION RING                                 |
| 8. VALVE BODY                                 | 28. OIL SEALS                                     |
| 9. SPOOL                                      | 29. SPRING AND REACTION WASHER                    |
| 10. CIRCLIP AND SPOOL END COVER               | 30. LOCATING COLLAR                               |
| 11. PISTON NUT, WASHER AND SPLIT PIN          | 31. INNER AND OUTER TUBE BEARING AND LOCKING RING |
| 12. PISTON RING                               | 33. ANCHOR BALL CUP (INNER)                       |
| 13. PISTON AND PISTON ROD                     | 34. ANCHOR BALL                                   |
| 14. GLAND SPACER AND RING                     | 35. GRUB SCREW                                    |
| 15. FABRIC WASHER                             | 36. ANCHOR BALL CUP (OUTER)                       |
| 16. WASHER                                    | 37. SPRING COVER                                  |
| 17. SCRAPER RING                              | 38. BALL STUD (MANUAL)                            |
| 18. INTERNAL CIRCLIP AND WASHER               | 39. RELIEF VALVE AND SPRING                       |
| 19. RUBBER ABUTMENT COVER                     | 40. PLUG AND PIN                                  |
| 20. SHIMS                                     | 41. BALL STUD (POWER)                             |

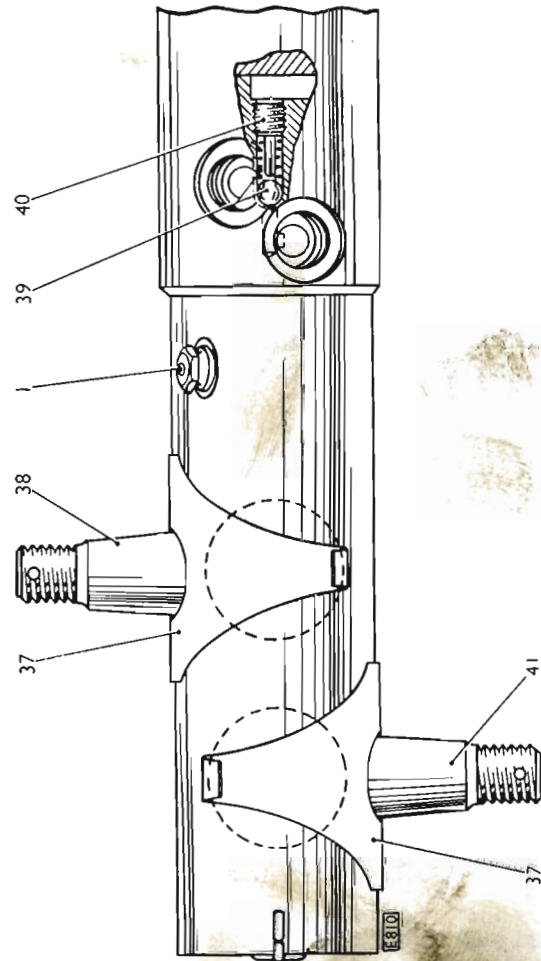


Fig. F4 Arrangement of hydraulic double-acting power cylinder

## Section 5      **HYDRAULIC DOUBLE-ACTING POWER CYLINDER** **—(WHEN FITTED)**

(See Fig. F4)

### **To Remove**

Drain the oil from the supply tank and pump (see Section 6).

Disconnect the feed and return oil pipes from the adaptors on the power cylinder and insert plugs into the cylinder port adaptors and the ends of the pipes to prevent the ingress of foreign matter.

Remove the split pins and nuts securing the "manual" and "power" ball studs to the drop arm and drag link. Withdraw the studs from their tapers, complete with the cylinder assembly, using the tool listed in the Maintenance Equipment.

Slide the rubber abutment cover from the anchor ball cup and remove the bolts and self-locking nuts securing the piston rod anchorage to the side member support bracket.

Remove the complete cylinder assembly and retain the shims and outer ball cup on the anchor ball by temporarily fitting the nuts to the retaining bolts.

### **To Dismantle**

Drain the oil from the cylinder by moving the piston rod in and out several times from one extreme end of its travel to the other.

Remove the nuts and bolts temporarily fitted to retain the shims between the anchor ball cups, and remove the outer cup, shims and grub screw from the anchor ball. Clamp the anchor ball in a vice equipped with suitable soft jaws and unscrew by means of a spanner, utilising the flats on the piston rod; remove the inner ball cup and abutment cover when clear of the ball.

Unclip the grease retainers from the ball studs and remove the lubricators and split pins from the ends of the unit.

Unscrew the end cover retaining the ball stud assembly and remove the two disc springs and the outer ball cup. Unscrew the lock ring and remove the spacer, "power" ball stud and inner ball cup.

Remove the grub screw, unscrew the outer ball cup and extract the "manual" ball stud.

Unscrew the locking ring at the piston rod end and withdraw the bearing and piston rod assembly from the unit. Remove the split pin, securing nut and piston from the rod, and detach the piston ring.

Slide the bearing assembly off the rod from the piston end and remove the seal. Extract the circlip from within the bearing and remove the washer, scraper ring, metal washer, fabric washer, gland seal and spacer.

The valve body, spool and inner tube assembly may

now be removed by a few light blows on a wooden block inserted in the ball stud end and resting on the inner ball cup. Remove the inner tube from the valve body, which is a light press fit.

Slide out the spool assembly from the valve body and remove the locating sleeve. Extract the inner ball cup, disc springs and backing plate by tapping the end of the operating sleeve on a wooden block.

Remove the circlip from the valve body and slide out the spool end cover. Remove the seals from the end cover, the bore and the outside diameter of the valve body. Leave the locating collar and pins in the valve body unless loose or damaged.

Unscrew the plug and pin at the cylinder end of the valve body, and remove the cylinder relief valve spring and ball.

Remove the self-locking nut from the spool, and remove the washer, the operating sleeve, spacer and collar. Slide off the reaction ring and spring and remove the seals from its inner and outer diameters.

### **To Inspect**

Wash all parts thoroughly in clean paraffin and examine them for wear or damage.

Examine the spool and valve body for burrs or score marks and if necessary clean the surface using a very fine emery cloth. Care should be taken not to round the sharp edges on the spool as this may affect the operation of the valve.

Inspect the mating surfaces of the operating and locating sleeves and if necessary remove any burrs or score marks with very fine emery cloth.

Apply a light film of oil to the spool and, **without fitting the seals**, insert the spool into the valve body to check the fit; the spool should pass freely through the body. Check that the operating sleeve is a sliding fit within the locating sleeve when lightly lubricated.

Examine the inner tube, piston, piston ring, piston rod and bearing for wear or scoring and renew if necessary.

Inspect the anchor ball and cups for wear and hammering; renew if the correct adjustment is not obtainable by removing the shims.

### **To Assemble**

#### **Valve Body Assembly**

Insert the relief valve ball and spring into the cylinder end of the valve body and screw in the plug and pin.

Renew any **locating pins** in the valve body that are loose or damaged.

Fit new seals into the valve body and on the spool end cover, slide the end cover into the body and secure with the circlip. Fit a new seal on the outside diameter of the valve body.

Assemble the inner tube to the valve body locating collar, carefully lining up the slot in the inner tube with the locating pin in the body.

### Valve Spool Assembly

Fit new seals to the reaction ring and assemble the washer, spring and ring to the spool. Both the washer and reaction ring should be fitted chamfer first on to the spool.

Assemble the collar on to the threaded part of the spool, and locate the spacer around the collar so that its holes line up with the corresponding holes in the valve body. Fit the operating sleeve to the collar and secure with the washer and locknut; tighten to a torque loading of 110 to 200 lb. in. (126 to 230 Kg. cm.).

Smear the surface of the operating sleeve with lubricant and slide the locating sleeve over it.

### Piston and Rod Assembly

**Note.**—Assembly of the bearing parts should always be made from the piston end of the rod to eliminate damage.

Insert the gland spacer, flange first, into the bearing recess and press in a new gland seal with the lip of the seal facing towards the bearing bush.

Fit the fabric washer behind the gland seal, followed by the metal washer, rubber scraper, scraper housing and circlip.

Assemble a new rubber "O" ring on to the outer diameter of the bearing and slide the bearing assembly on to the piston rod.

Fit the piston ring to the piston and assemble the piston to the rod with the recess facing outwards. Fit the washer and nut, tightening to a torque loading of 35 to 45 lb. ft. (4.85 to 6.2 Kg. M.). Care should be taken to ensure that the loading is not exceeded, otherwise the piston may swell and bind in the tube. Fit the split pin.

### Final Assembly

With the inner tube assembled to the valve body, compress the piston ring and slide the piston rod assembly into the tube to its extreme limit, locating the recessed end of the bearing in the end of the tube.

Slide the spool assembly into the valve body, ensuring that the small hole in the spacer locates on the dowel in the end of the valve body.

Smear the two disc springs with grease and assemble them to the recess in the inner ball cup with their inner diameters nearest each other.

Slide the backing plate, chamfer first, into the operating sleeve followed by the inner ball cup.

Hold the outer tube and slide the complete inner assembly into the outer tube from the anchorage end. Line up the two assemblies so that the oil ports in the valve body correspond radially with the ports in the outer tube.

Position the power cylinder horizontally to prevent the spool assembly falling out of the valve body, then screw the bearing locking ring into the end of the outer tube until the ports line up longitudinally and the slot in the ring is in line with the split pin hole.

Apply grease to the spherical surface of the "manual" ball stud and assemble through the holes in the outer tube and sleeves, ensuring that the limit peg is located in the two elongated slots provided.

Insert the outer ball cup into the adjusting nut and screw in the assembly to its limit in the operating sleeve. Unscrew the adjustment nut one-quarter of a turn, to provide the correct tension on the disc springs. Lock with the grub screw but do not over-tighten.

Insert the next ball cup, the one with the larger diameter, then apply grease to the "power" ball stud and fit it through the hole in the outer tube.

Fit the spacer and screw in the lock ring ensuring that the spacer and the locating sleeve are in mid-position radially. The lock ring must be tightened securely to ensure satisfactory locking of the components between itself and the bearing.

Fit the outer ball cup and fit the two disc springs into the ball cup recess.

Screw home the end cover and unscrew one-quarter of a turn to provide the correct tension on the disc springs.

Fit split pins to the end cover and bearing locking rings noting that if the pin holes and slots do not line up, new  $\frac{3}{4}$  in. (3.57 mm.) diameter holes must be drilled in the outer tube; **on no account adjust the cover or ring to suit.**

Screw in the lubricators and replenish with grease. Fit the grease retaining pads to the spring covers and clip them into position over the ball studs.

Slide the rubber abutment cover and inner ball cup on to the piston rod, screw on the anchor ball and lock with the grub screw. Make the final assembly with the shims and outer ball cup when fitting the hydraulic cylinder to the support bracket on the side member.

### To Fit

Reverse the procedure for removal, and fill the hydraulic oil supply tank in accordance with the instructions given in Part A, using the recommended grade of oil (*see Part S*).

## Section 6

HYDRAULIC PUMP AND OIL SUPPLY TANK  
—(WHEN FITTED)

(See Figs. F5 and F6)

**To Remove**

**Note.**—On certain chassis, the oil tank is frame mounted, therefore the following text should be read accordingly.

Disconnect the oil inlet and outlet pipe couplings from the pump and oil supply tank.

Remove the nuts securing the pump to the drive housing and detach the pump complete with oil supply tank.

Drain the oil from the pump and supply tank through the inlet and outlet ports and blank off the pipe entries to prevent the ingress of foreign matter.

Thoroughly clean the exterior of both pump and oil supply tank.

**To Dismantle**

Clamp the pump body in a vice.

Remove the setbolt and lock washer, or alternatively the securing nut and washer, from the pump drive shaft and remove the drive gear and key.

Detach the cover assembly from the oil supply tank by removing the central securing setscrew and washer. Withdraw the spring, seating washer and filter element.

Using a box spanner, remove the mounting stud complete with the hollow stud for the cover setscrew.

Remove the supply tank body, filter support and reinforcement plate from the pump and the gasket seals from the recesses in the top of the pump cover. Remove the gasket retainer from the supply tank mounting flange.

**Note.**—The venturi is pressed into the pump cover and should **not** be removed.

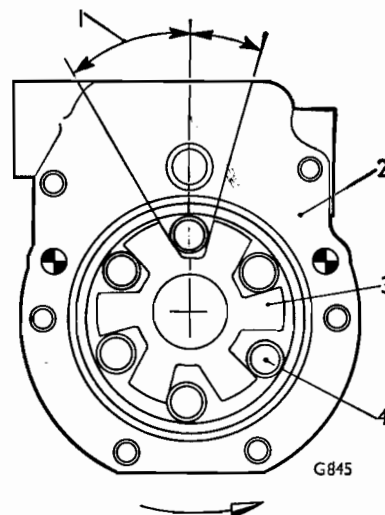
Remove the cap screws securing the cover to the pump body. Re-position the pump in the vice so that it is held vertically to prevent any parts from falling out when separating the cover from the pump body. Detach the "O" ring from the face of the pump body.

Remove the rollers from the drive slots in the roller carrier. Slide the roller carrier off the shaft and remove the drive pin.

Lift out the cam insert and lock peg from the pump body.

Remove the screws and lockwashers securing the end plate to the pump body and remove the end plate complete with the shaft, bearing assembly and gasket. Remove the circlip and tap out the shaft and bearing assembly.

Unscrew the valve cap carefully and withdraw the relief valve assembly, flow control valve and spring from the pump body.

**Key to Numbers:—**

1. GREATER ANGLE IN LEADING POSITION
2. PUMP BODY
3. ROLLER CARRIER
4. ROLLER

**Fig. F5 Installation of roller carrier in hydraulic pump**

Withdraw the oil seal from the body, taking care not to damage the drive shaft bush.

**To Assemble**

Wash all parts in clean paraffin and air dry or wipe clean with a lint free cloth.

Lightly smear all metal parts with oil before assembly.

Check the pump body and cover for wear; renew either part if the bushes are worn or the faces pitted.

Fit a **new** seal into the pump body. Grease the seal lip and fit with the lip pointing **inwards** towards the recess for the roller assembly. An arbor press is usually employed for this purpose, using a 1-7/8 in. (30-96 mm.) diameter steel bar as a piloting tool. Press the seal fully home ensuring that it is not crushed.

Fit the cam lock peg into its hole in the bore of the body. Inspect the cam insert for wear and renew if worn or damaged. Fit the cam insert with its slot located over the cam lock peg and ensure that it is properly seated in the body.

Inspect the shaft and bearing assembly; if the bearing balls are loose or excessive grease has seeped out, renew the bearing.

**Note.**—Do not fit the bearing until the body and end plate have been assembled as the shaft must be fitted drive end first through the body.

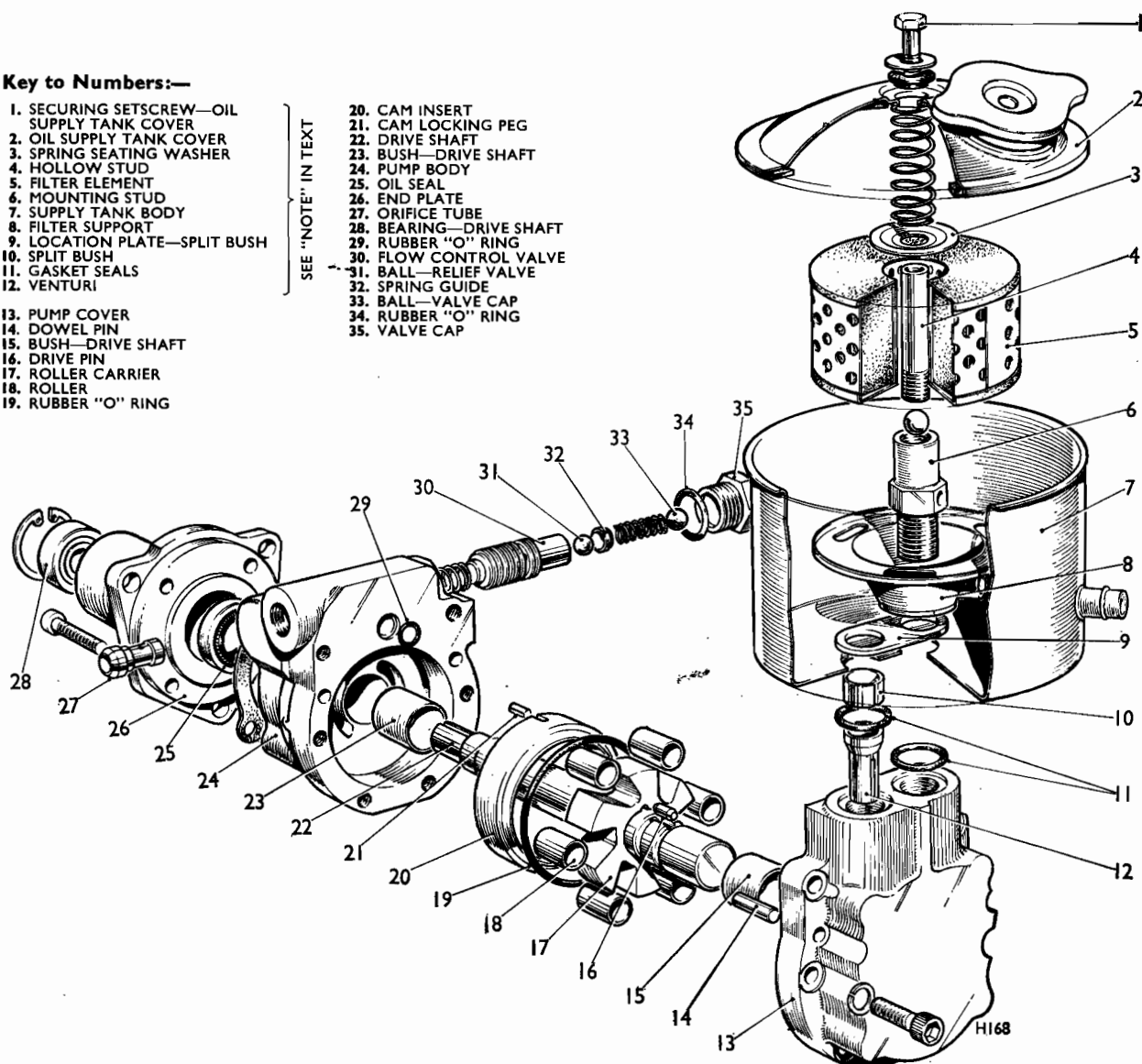
Secure the end plate, with its gasket, to the body and insert the shaft, drive end first, through the body.

**Key to Numbers:—**

1. SECURING SETSCREW—OIL SUPPLY TANK COVER
2. OIL SUPPLY TANK COVER
3. SPRING SEATING WASHER
4. HOLLOW STUD
5. FILTER ELEMENT
6. MOUNTING STUD
7. SUPPLY TANK BODY
8. FILTER SUPPORT
9. LOCATION PLATE—SPLIT BUSH
10. SPLIT BUSH
11. GASKET SEALS
12. VENTURI
13. PUMP COVER
14. DOWEL PIN
15. BUSH—DRIVE SHAFT
16. DRIVE PIN
17. ROLLER CARRIER
18. ROLLER
19. RUBBER "O" RING

SEE "NOTE" IN TEXT

20. CAM INSERT
21. CAM LOCKING PEG
22. DRIVE SHAFT
23. BUSH—DRIVE SHAFT
24. PUMP BODY
25. OIL SEAL
26. END PLATE
27. ORIFICE TUBE
28. BEARING—DRIVE SHAFT
29. RUBBER "O" RING
30. FLOW CONTROL VALVE
31. BALL—RELIEF VALVE
32. SPRING GUIDE
33. BALL—VALVE CAP
34. RUBBER "O" RING
35. VALVE CAP

**Fig. F6 Exploded view of typical hydraulic pump and oil supply tank**

**Fit a sleeve over the drive end of the shaft to avoid damaging the oil seal.**

Using a suitable dolly, tap the bearing on to the shaft and press it fully home in the end plate. Secure with a new circlip.

Fit the drive pin in the shaft.

Inspect the roller carrier, paying particular attention to the end faces; renew if scored or damaged. Fit the carrier on the drive shaft so that its slot engages on the drive pin. Check that the carrier seats properly in the cam insert.

Examine the rollers for wear, paying particular attention to the finish on their ends and renew if scored, damaged or out of round. Install the rollers in the carrier driving slots; refer to Fig. F5 for correct

installation, i.e. correct face of slots driving the rollers.

Using a straight edge across the surface of the cam insert, check the end clearance of the carrier and rollers by inserting feeler gauges. If end clearance exceeds 0.002 in. (0.05 mm.), renew the carrier, rollers and cam insert. **Note.**—These items are supplied only in matched sets.

Fit new "O" rings in the groove in the joint face of the body and on the cam insert.

Position the cover over the end of the shaft and secure it to the body with the cap screws and lock-washers; tighten the screws evenly to a torque loading of 18 lb. ft. (2.5 Kg. M.) and check that the shaft rotates freely without binding.

Check the tension of the flow control spring; it should be 8 to 9 lb. (3.6 to 4.1 Kg.) when compressed to a length of 0.82 in. (20.83 mm.). If it is not, fit a new spring.

Fit the spring and flow control valve into the bore in the pump body, inserting the valve so that its exposed ball end enters last. Ensure that the valve is not sticking.

Install the relief valve assembly and the valve cap with a new "O" ring. Tighten the cap to a torque loading of 30 to 35 lb. ft. (4.15 to 4.84 Kg. M.).

Insert the gasket retainer in the supply tank mounting flange and install new gasket seals in the top of the pump.

Position the supply tank body, reinforcement plate and filter support on to the pump cover and secure them with the mounting stud; tighten the stud to a torque loading of 30 to 35 lb. ft. (4.15 to 4.84 Kg. M.).

Fit a new filter element as instructed in Part A.

Fit the key and drive gear on the pump shaft and secure with the setbolt and lockwasher or nut and washer. Tighten to a torque loading of 15 to 20 lb. ft. (2.07 to 2.76 Kg. M.).

**Note.**—Ensure that the pressure relief hole in the supply tank filler cap sealing washer is clear.

#### To Fit

Fit the hydraulic pump and supply tank by reversing the procedure for removal noting the following points:—

Ensure that the mating faces of the drive housing and hydraulic pump are free from burrs.

Examine the joint on the drive housing for damage and if necessary renew. Ensure that all traces of old jointing compound are removed and fit a new joint, using a non-hardening jointing compound.

When the pump and pipe couplings are secured, fill the hydraulic oil supply tank in accordance with the instructions given in Part A, using the recommended grade of oil (*see Part S*).

## Section 7

### DIMENSIONS OF SHIMS AVAILABLE

Alternative shims listed hereunder are available to enable correct clearances to be obtained on assembly.

For Part	Thickness
Ball Pegs—Steering Nut .. .. .	0.003 in. (0.076 mm.) 0.005 in. (0.127 mm.) 0.007 in. (0.178 mm.) 0.010 in. (0.254 mm.)
Centralizing Adjusters—Rocker Shaft .. .. .	0.004 in. (0.102 mm.) 0.010 in. (0.254 mm.) 0.031 in. (0.787 mm.) 0.062 in. (1.575 mm.)
Anchor Ball Cup Assembly—Hydraulic Cylinder (when fitted) .. .. .	0.005 in. (0.127 mm.) 0.010 in. (0.254 mm.) 0.024 in. (0.609 mm.)

## Section 8

### FAULT FINDING GUIDE—POWER ASSISTED STEERING (WHEN FITTED)

Symptom	Cause	Remedy
A. Binding .. .. .	1. Power Cylinder—ball stud sticking .. .. .	Check locating sleeve for lack of lubrication. Renew sleeve and ball stud if worn ( <i>see Section 5</i> ).
	2. Power Cylinder—spool sticking in valve body .. .. .	Inspect spool and valve body for burrs; if damaged, renew ( <i>see Section 5</i> ).

**FAULT FINDING GUIDE** (*continued*)

Symptom	Cause	Remedy
B. Excessive play in steering .. ..	1. Power Cylinder — excessive clearance between ball stud and cups .. .. .	Check ball studs, cups and spring discs for wear; renew if necessary ( <i>see Section 5</i> ).
	2. Power Cylinder—locating sleeve loose .. .. .	Check end cover for correct adjustment ( <i>see Section 5</i> ).
C. Heavy steering .. .. .	1. Oil Pump—low output .. .	Check power cylinder relief valve for operation, if correct, overhaul oil pump ( <i>see Sections 5 and 6</i> ).
	2. Power Cylinder — valve spool leaking .. .. .	Inspect for wear or score marks. If necessary renew ( <i>see Section 5</i> ).
	3. Power Cylinder — oil leaking into inner tube .. .. .	Renew the inner tube and piston ring ( <i>see Section 5</i> ).
D. Noisy operation .. ..	1. Low oil level in supply tank ..	Refill supply tank ( <i>see Part A</i> ).
	2. Worn oil pump .. ..	Overhaul ( <i>see Section 6</i> ).
E. Steering chatter .. ..	1. Power Cylinder—piston rod end float .. .. .	Examine the piston rod ball and cup anchorage for security. Renew if worn ( <i>see Section 5</i> ).
F. Loss of Power Assistance ..	1. Low oil level in supply tank ..	See item D1.
	2. Worn oil pump .. ..	See item D2.
	3. Oil leakage from pipe lines ..	Check pipe unions and hose for security or damage; tighten or renew if necessary.

# PART G31

## FRONT AXLE

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G31

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## Section 1

## BRAKE DRUMS

### To Remove

Remove the road wheel.

Using a suitable socket spanner, remove the set-screws from the recesses in the brake drum.

Insert two  $\frac{3}{8}$  in. U.N.F. setscrews into the tapped holes provided in the brake drum and tighten them **evenly and in sequence** until the brake drum is free. **Carelessness in tightening the screws may result in cracking the drum.**

Should difficulty be experienced in withdrawing the drum due to scores, turn the head of the brake adjuster in an **anti-clockwise** direction until the brake drum is free.

### To Fit

Reverse the above procedure, finally adjusting the brakes as instructed in Part K.

## Section 2

## HUBS

### To Remove

Remove the brake drum (*see Section 1*).

Remove the hub cap.

**Note:**—On certain types of axle the **left-hand** side hub retaining nut has a **left-hand** thread and the **right-hand** side nut has a **right-hand** thread, whereas on other types **both** hub retaining nuts have **right-hand** threads.

Withdraw the split pin and remove the clamp bolt from the hub retaining nut; unscrew the nut by means of a short bar inserted in the clamp bolt hole and lift off the "D" washer.

If further removal is necessary it should be noted that a **new** oil seal must be fitted on assembly.

Pull off the hub; if difficulty is experienced in removing the hub, use the withdrawal tool listed in the Maintenance Equipment.

The cone of the hub inner bearing is **not** a tight fit on the swivel and will be retained inside the hub by the oil seal when the hub is removed.

Remove the abutment ring from the swivel.

The cups of both inner and outer bearings are removed from the hub by driving them out with a hammer and suitable soft drift.

If more than one hub is being removed, mark all bearing cups, cones and roller assemblies to facilitate matching on assembly.

### To Fit

The hub taper roller bearings are adjusted by means of a split nut secured by a clamp bolt; during assembly ensure that there is no pre-loading of the hub bearings.

Wash clean and thoroughly dry both roller bearing assemblies.

Fit the cups of the inner and outer bearings to the hub, ensuring that they are fully home against their respective flanges inside the hub.

Using the tool listed in the Maintenance Equipment pack with grease the cone assembly of the inner taper roller bearing and fit the assembly to the hub.

Smear with grease the **new** lip type seal and the abutment ring; fit the seal to the hub with the **lip facing the hub bearings**. **Note:**— When fitting the seal, it must be pressed into the hub until it is **flush** with the outer face of the hub. Fit the abutment ring to the swivel, **chamfer facing the swivel lugs**.

**Do not pack the hub cavity or the hub cap with grease**, but lightly coat the stub axle and the internal face of the hub cap with grease to prevent corrosion (*for specification of grease see Part S*).

**Note:**—It is important when changing from one type of grease to another, that all the original grease is removed before introducing the new. **They must not be mixed.**

Fit the hub to the swivel, ensuring that the lip of the seal is not damaged as it locates on the abutment ring.

Using the tool listed in the Maintenance Equipment pack with grease the cone assembly of the outer taper roller bearing and fit the bearing onto the swivel and into the hub.

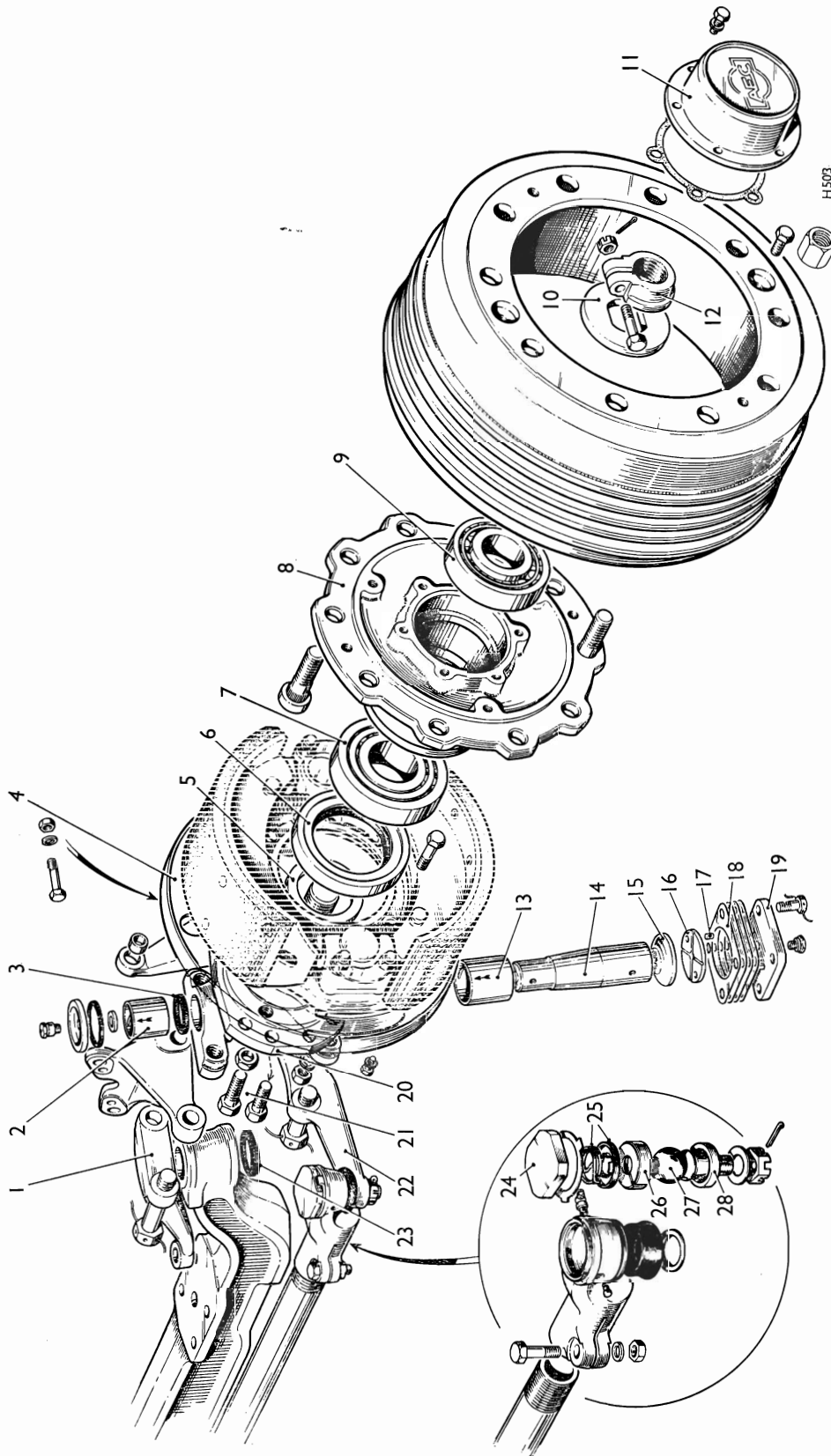
Fit the "D" washer to the swivel, followed by the hub retaining nut, flanged side towards the "D" washer.

### To Adjust

With a short bar inserted in the clamp bolt hole of the hub retaining nut; tighten the nut until the bearings just "nip" and tightness can just be felt when the hub is rotated.

Slacken the hub retaining nut an eighth of a turn to permit the hub to rotate freely without hard spots. Fit the clamp bolt and nut and tighten. Ascertain that there is no perceptible amount of "rock" in the hub.

Finally, lock the clamp bolt nut with a **new** split pin.



**Key to Numbers:—**

- |  |                               |                             |                                       |
|--|-------------------------------|-----------------------------|---------------------------------------|
| 1. SWIVEL LEVER (STEERING BOX SIDE ONLY) | 8. HUB                        | 15. THRUST BUTTON           | 22. STEERING LEVER                    |
| 2. SWIVEL PIN BUSH—UPPER                 | 9. TAPER ROLLER BEARING—OUTER | 16. THRUST WASHER           | 23. SEAL RING                         |
| 3. "O" RING                              | 10. "D" WASHER                | 17. DOWEL                   | 24. SOCKET TOP COVER                  |
| 4. DUST SHIELD                           | 11. HUB CAP                   | 18. SHIMS                   | 25. ADJUSTMENT CAP AND LOCKING SPRING |
| 5. ABUTMENT RING                         | 12. HUB RETAINING NUT         | 19. THRUST PAD PLATE        | 26. BALL PIN CUP—UPPER                |
| 6. OIL SEAL                              | 13. SWIVEL PIN BUSH—LOWER     | 20. SWIVEL                  | 27. BALL PIN                          |
| 7. TAPER ROLLER BEARING—INNER            | 14. SWIVEL PIN                | 21. STEERING STOP SETSCREWS | 28. BALL PIN CUP—LOWER                |

**Fig G2. Front axle with thrust washer and spherical thrust button (see "Note" Section 3)**

## Section 3

## SWIVELS

### To Remove

**Note:**—The thrust on the swivel pins may be taken either by two similar cylindrical thrust pads (*see Fig. G1*), or by a thrust washer and spherical thrust button (*see Fig. G2*).

Remove the hub (*see Section 2*).

Remove the fork end pin from the brake operating lever.

Remove the brake shoe carrier complete with brake shoes, adjuster and expander units, and dust shield.

Disconnect the track rod and, if the swivel on the steering box side is being removed, the steering drag link also, by removing the split pins and nuts which hold the ball studs into the swivel and steering levers; then drive the ball studs out of their tapers with the withdrawal wedge listed in the Maintenance Equipment.

Remove the brake air chamber (*see Part K*).

Disconnect the lubrication pipe(s) (when fitted) from the swivel.

Remove the lubricator from the swivel top cover and remove the cover, distance piece (when fitted) and seal.

Unfasten the lockwire and remove the setbolts from the thrust pad plate. Withdraw the plate complete with the lower thrust pad and shims (*see Fig. G1*), or thrust washer, dowels, spherical thrust button and shims (*see Fig. G2*). Note the thickness of shims fitted, for reassembly purposes.

When fitted, remove the nut and washer from the cotter pin securing the swivel pin in the axle beam and, using a hammer and a suitable soft drift, drive the cotter pin from the beam.

Support the swivel assembly by some suitable means and, using a hammer and a suitable soft drift, drive out the swivel pin; retain the "O" ring and seal ring.

### To Dismantle

Unfasten the lockwire and remove the setbolts from the air chamber mounting bracket. Separate the swivel lever from the steering box side swivel and the distance piece (when fitted) from the non-steering box side swivel.

Unfasten the lockwire and remove the setbolts and steering lever.

Do not remove the steering stop setscrews unless necessary.

The bushes should only be pressed from the swivel lugs if they require renewing; note their approximate positions to assist in assembly.

### To Assemble

Reverse the procedure given in "To Dismantle" noting the following points:—

The upper and lower swivel pin bushes are a press fit in the swivel lugs. After fitting **new** bushes, they must be reamed to give the clearance quoted below, using the reamer listed in the Maintenance Equipment. This is **not** applicable to the "pre-finished" type bushes.

The **upper** bush must not be a "flush" fit in the swivel lug but should stand proud of the lug at its upper end with a clearance of 0.183 to 0.193 in. (4.65 to 4.90 mm.) between the bottom of the bush and the lower face of the lug. Fit the bush to the swivel with the arrow etched on the bush pointing **towards** the **top** of the swivel and the split in the bush facing **towards** the stub axle.

The **lower** bush must be fitted to the swivel with the top of the bush "flush" with the upper face of the swivel lug. Fit the bush to the swivel with the arrow pointing **towards** the **top** of the swivel and the split in the bush facing **away** from the stub axle.

The clearance between the upper and lower bushes and the swivel pin, when new, is approximately 0.001 to 0.003 in. (0.025 to 0.076 mm.).

### To Fit

Examine the faces of the thrust pads or thrust washer and spherical thrust button for scoring or wear and renew, if necessary.

**On axles fitted with cylindrical thrust pads** (*see Fig. G1*), the **lower** thrust pad has lubrication grooves on its thrust face; ensure that the pad is fitted **chamfered side** to the thrust pad plate.

Similarly, the **upper** thrust pad (without lubrication grooves) must be fitted **chamfered side** to the swivel pin.

**On axles fitted with a thrust washer and spherical thrust button** (*see Fig. G2*), ensure that the washer is secured on the thrust pad plate with the dowels and that the lubrication grooves face upwards.

**On both types**, ensure that the lubrication holes in the thrust pad plate, thrust pads or thrust washer and button, and swivel pin are clear and free from foreign matter.

Check the condition of the "O" ring and seal ring and, if necessary, renew. Fit the "O" ring to the swivel in the recess between the bottom of the upper bush and the lower face of the upper swivel lug.

Assemble the swivel assembly on the end of the axle beam and support by some suitable means. Locate the seal ring between the top face of the lower swivel lug and the lower face of the axle beam boss.

**On axles fitted with cylindrical thrust pads** (see Fig. G1), insert the swivel pin, align the cotter pin groove in the pin with the hole in the beam and lightly drive the swivel pin into the beam. Care must be taken not to damage the face of the thrust pad projecting from the end of the pin.

Align the cotter pin groove in the pin with its hole in the beam and secure with a **new** cotter pin.

**On axles fitted with a thrust washer and spherical thrust button** (see Fig. G2), insert the swivel pin and lightly drive it into the taper seating. Care must be taken not to damage the spherical face in the end of the pin.

#### Both types

**Note:**—To simulate road conditions it is necessary, when obtaining the following clearance, for the weight of the swivel to be supported by some suitable means.

Assemble the thrust pad plate complete with thrust pads or thrust washer and button, **without shims**, to

the swivel and screw up two of the retaining setbolts diagonally opposite each other.

Tighten the setbolts evenly until a clearance of 0.003 in. (0.076 mm.) is obtained between the upper face of the axle beam boss and the mating face of the swivel. Measure the resultant gap between the face of the thrust pad plate and the lower face of the bottom swivel lug. Remove the plate and select shims equal to this dimension (see Section 6).

Refit the plate complete with the selected shims, tightening the setbolts evenly and in sequence.

Check that the clearance between the axle beam and the swivel is 0.001 to 0.003 in. (0.025 to 0.076 mm.).

**Note:**—After running the vehicle for 50 to 100 miles (80 to 160 Km.) it will be necessary to check the clearance again and adjust the shims accordingly.

Check for freedom of movement and, if satisfactory, lock the thrust pad securing setbolts with wire.

Fit the swivel top cover, distance piece (when fitted) and seal, securing them with the lubricator.

Fit the remaining parts in the reverse order to their removal ensuring that the assembly is lubricated before use.

## Section 4

## TRACK ROD SOCKET ASSEMBLIES

### To Dismantle

Mark the position of the socket assembly on the track rod tube.

Slacken the clamp bolt, then unscrew the socket assembly from the tube. The tube is screwed with a left-hand thread at one end and a right-hand thread at the other end.

Remove the rubber gaiter complete with retaining ring from the ball pin taper.

Clamp the socket assembly in a vice, unlock the tab washer and unscrew the socket top cover.

Unscrew and remove the adjustment cap complete with spring.

Remove the upper ball pin cup and lift out the ball pin.

If necessary, press the lower ball pin cup from the housing.

### To Assemble

Press the lower ball pin cup into the housing.

Insert the ball pin and upper ball pin cup, locating the split in the cup on the dowel in the housing.

Screw in the adjustment cap to lightly load the ball stud, ensuring that the stud moves freely under finger pressure. Fit the spring, locating the straight inner leg of the spring across the cap slots and the short outer leg in the nearest hole in the housing to provide light spring load on the adjustment cap.

**Note:**—Do not stretch the spring unduly to line up with a locating hole.

Fit a **new** tab washer, locating the small tab in the indent in the socket housing. Fit and tighten the top cover and lock with the tab washer.

Fit the retaining ring **inside** the gaiter and fit the assembly to the ball pin taper, locating the gaiter bead in the housing groove.

Screw the socket assembly on to the track rod tube aligning the marks made on dismantling.

Check the alignment of the road wheels as instructed in Section 5.

Finally lock the assembly with the clamp bolt

## Section 5

## ROAD WHEELS

### To Align

Check the adjustment of each ball and socket end of the track rod (*see Section 4*).

Set the road wheels in a straight ahead position and adjust so that they are **parallel** between points on the rims at a height equal to that of the wheel centres. The ends of the track rod are provided with right and left-hand threads and, after loosening the clamp bolts, adjustment is effected by rotation of the

track rod.

Align the socket ends before tightening the clamp bolts.

Adjustable steering stop setscrews are fitted behind the swivels to limit the lock of the front wheels. Maximum lock should be set so as to prevent the nut in the steering box reaching the end of its travel (*see also Part F*).

## Section 6

## DIMENSIONS OF SHIMS AVAILABLE

The following shims are available, in order that the correct clearance between the axle boss and the swivel may be obtained as described in Section 3.

Part	Thickness
Shim—Front Axle Swivel .. .. .	0.002 in. (0.05 mm.)
	0.005 in. (0.13 mm.)
	0.010 in. (0.25 mm.)

NOTES

## PART H34

# REAR AXLE

### CONTENTS

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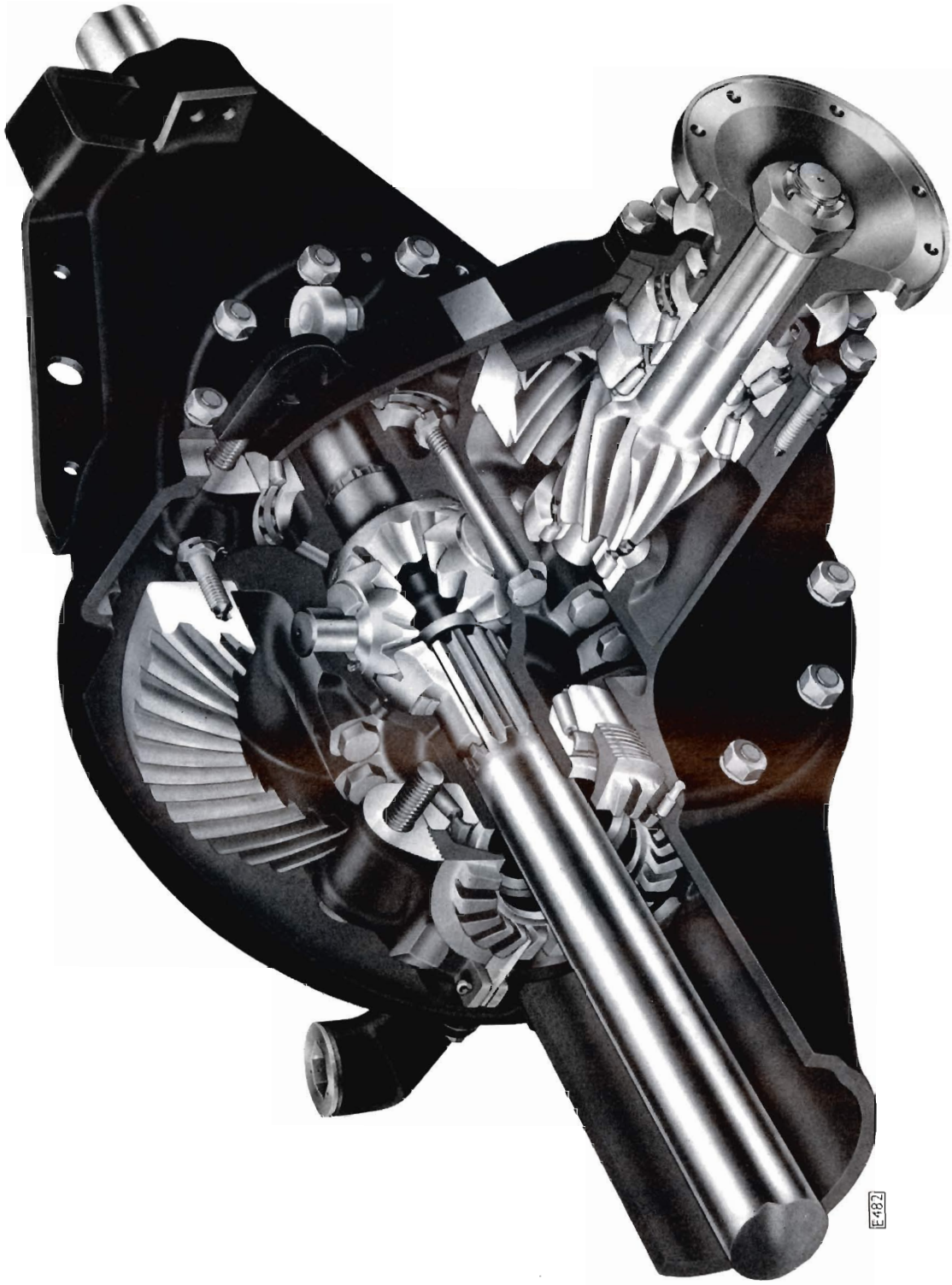


Fig. H1 Cut-away view of rear axle reduction gear (early type pinion assembly)

## Section 1

## DESCRIPTION

(See Figs. H1, H4, H8 and H12)

The rear axle is of the spiral bevel type with fully floating axle shafts.

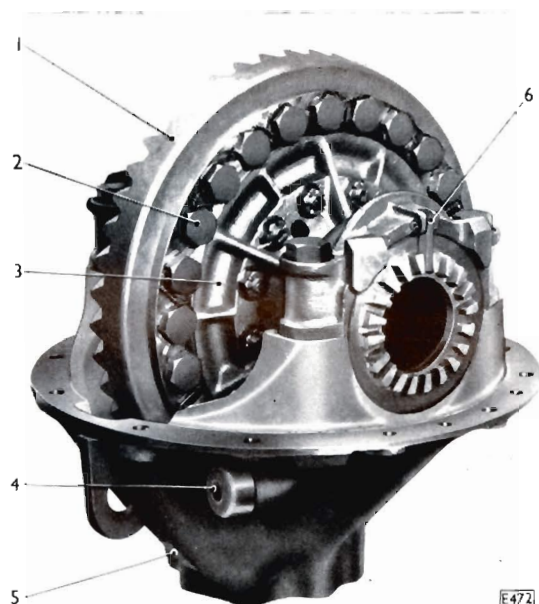
The axle casing comprises two pressed steel portions, welded together to form a banjo, together with a pressed steel dished cover welded to the rear face; a single casting bolted to the front face of the casing, carries the bevel pinion, bevel wheel and differential assembly.

The bevel wheel is secured with setbolts to the differential casing, which is carried on two taper roller bearings, whilst the bevel pinion is straddle mounted between two opposed taper roller bearings at the front and a parallel roller bearing at the rear. On early chassis, the two opposed taper

roller bearings are of equal size (see Figs. H1 and H4), whilst on later chassis the inner bearing diameter has been increased (see Fig. H8). Thrust washers are fitted to the differential bevel wheels and bevel pinions.

The axle shafts have splined inner ends, whilst the outer end of each shaft has an integral flange secured to the wheel hub, this in turn is carried on two taper roller bearings in the axle casing; lip type seals are fitted to each hub.

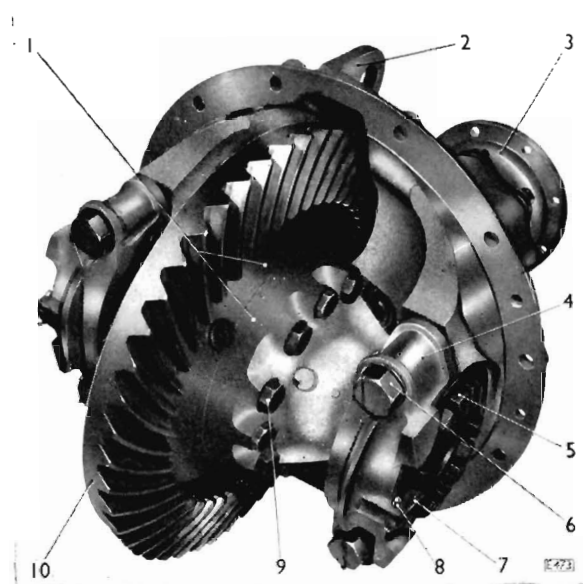
A drain plug and a combined filler and level plug are provided on the axle casing; a breather is fitted to the reduction gear casing.



**Key to Numbers:—**

1. BEVEL WHEEL
2. SETBOLT
3. DIFFERENTIAL HALF-CASING
4. BREATHER
5. AXLE RATIO STAMPED HERE
6. LOCKING PIECE—BEARING ADJUSTING NUT

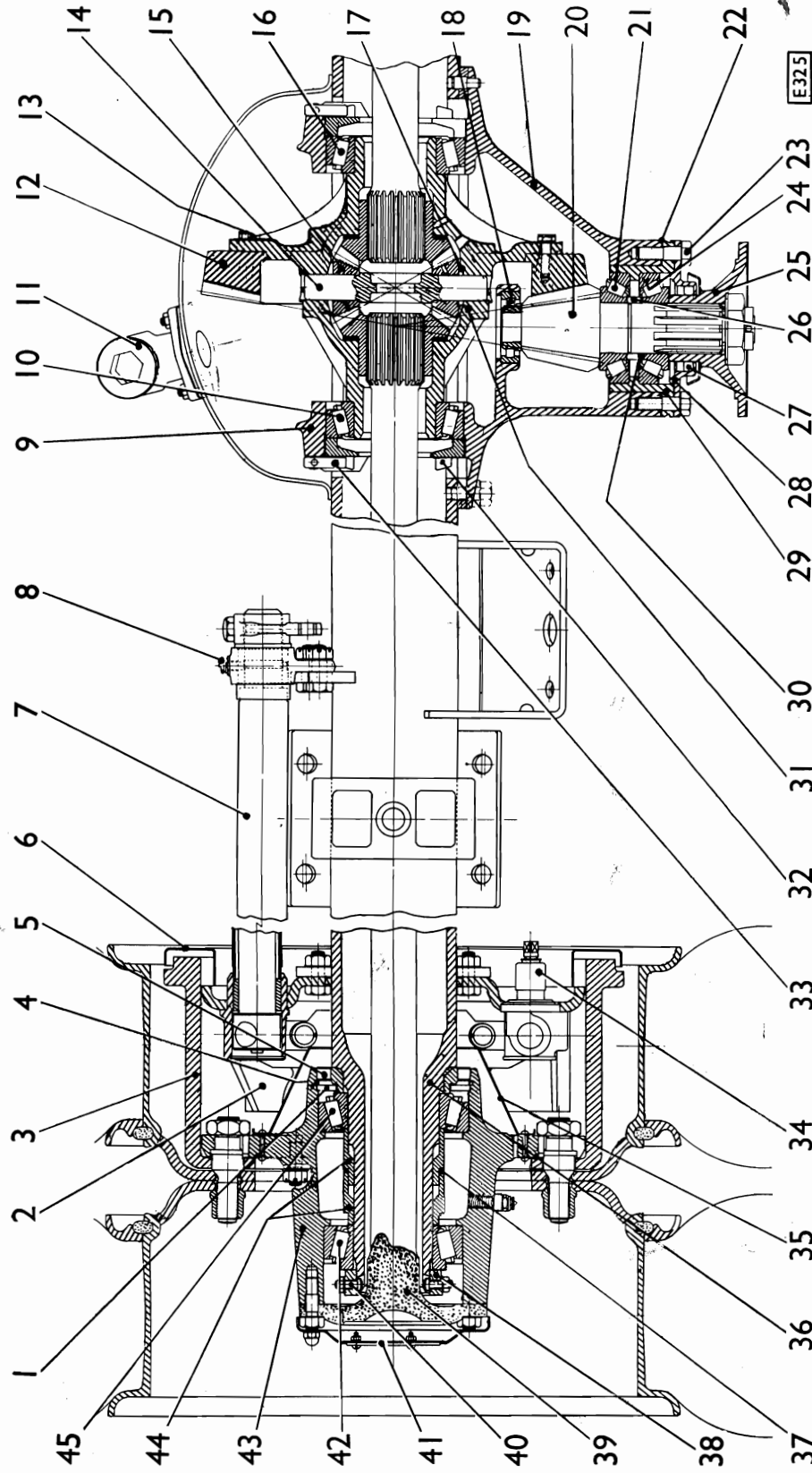
**Fig. H2** Reduction gear unit



**Key to Numbers:—**

1. DIFFERENTIAL CASING
2. LIFTING EYE
3. COUPLING FLANGE
4. BEARING CAP
5. DIFFERENTIAL BEARING ADJUSTING NUT
6. BEARING CAP SETBOLT
7. ADJUSTING NUT LOCKING PIECE
8. SPLIT PIN
9. DIFFERENTIAL CASING SECURING BOLT
10. BEVEL WHEEL

**Fig. H3** Reduction gear unit showing bevel wheel and differential casing



**Key to Numbers:—**

- 1. BEARING WITHDRAWAL WASHER
- 2. BRAKE SHOE
- 3. BRAKE DRUM
- 4. CIRCLIP
- 5. SEAL
- 6. DUST SHIELD
- 7. BRAKE CAMSHAFT
- 8. LUBRICATOR
- 9. DIFFERENTIAL BEARING CAP
- 10. DIFFERENTIAL BEARING
- 11. FILLER PLUG
- 12. BEVEL WHEEL

- 13. HALF DIFFERENTIAL CASING
- 14. DIFFERENTIAL SPIDER
- 15. DIFFERENTIAL BEVEL PINION
- 16. DIFFERENTIAL BEARING
- 17. DIFFERENTIAL BEVEL PINION THRUST WASHER
- 18. BEVEL PINION SPIGOT BEARING
- 19. REDUCTION GEAR CASING
- 20. BEVEL PINION
- 21. BEVEL PINION INNER BEARING
- 22. SHIMS
- 23. BEVEL PINION BEARING HOUSING RETAINING SETBOLTS

- 24. BEVEL PINION OUTER BEARING
- 25. COUPLING FLANGE
- 26. BEARING SPACER
- 27. OIL SEAL
- 28. OIL SEAL HOUSING
- 29. BEARING HOUSING
- 30. BEARING ADJUSTING SHIMS
- 31. HALF DIFFERENTIAL CASING
- 32. DIFFERENTIAL BEARING ADJUSTING NUT
- 33. ADJUSTING NUT LOCKING PLATE
- 34. BRAKE ADJUSTER

- 35. GREASE GUARD
- 36. AXLE TUBE
- 37. HUB BEARING ADJUSTING SHIMS
- 38. HUB BEARING NUT
- 39. AXLE SHAFT
- 40. HUB BEARING NUT LOCK BOLT
- 41. HUB CAP
- 42. HUB OUTER BEARING
- 43. HUB
- 44. HUB BEARING DISTANCE PIECES
- 45. HUB INNER BEARING

**Fig. H4 Arrangement of rear axle (early type pinion assembly)**

## Section 2

## MAINTENANCE

At intervals quoted in Part A the following points require attention:—

Examine all the various flanged joints for signs of oil leakage and tighten if necessary.

Examine the brake shoe linings through the apertures in the dust shields, also the surplus lubricant escape holes in the hubs, for signs of escaping lubricant. The appearance of lubricant at these points indicates that either too much lubricant has been applied to the hub bearings or that the seal needs renewing.

Check the tightness of the spring securing bolts and the road wheel nuts (L.H. thread on L.H. side, R.H. thread on R.H. side).

Remove, clean and fit the axle breather.

Top-up or drain and refill the axle with oil to the level of the filler plug hole. To drain the rear axle, remove the drain plug from beneath the axle casing.

**The hub bearings should only be lubricated at overhaul periods (see "Note" in Section 6).**

## Section 3

## AXLE SHAFTS—TO REMOVE AND FIT

(See Fig. H4)

### To Remove

Remove the hub cap by unscrewing the dome nuts.

Unscrew the nuts securing the axle shaft flange to the hub, then withdraw the axle shaft.

### To Fit

Slide the axle shaft into the axle casing and locate its splines with those in the differential bevel wheel.

Fit and tighten the axle shaft flange nuts.

Fit the hub cap.

On certain chassis longer driving shafts are used. To ensure that correct shafts are fitted, a baulk pin in each hub mates with a hole in the flange of the **long** shafts.

Care should be taken when assembling each driving shaft to observe that the mating faces of the shaft flange and the hub make contact before tightening the securing nuts.

## Section 4

## BRAKE DRUMS—TO REMOVE AND FIT

(See Fig. H4)

### To Remove

Scotch the front wheels both in front and behind.

Jack up the axle or each wheel in turn and remove the road wheel (see Part A).

Slacken off the brake adjustment (see Part K).

Remove the nuts or setscrews securing the brake drum to the hub.

Paint around all studs and holes with "easing" oil or paraffin.

Insert four  $\frac{1}{2}$  in. B.S.F. (or, for "ribbed" brake drums,  $\frac{1}{2}$  in. U.N.F.) setscrews into the withdrawal holes in the drum, and tighten these equally in succession, a little at a time, to ensure that the brake drum is withdrawn evenly.

**Carelessness in tightening the screws may result in cracking the drum.**

### To Fit

**Note:**—On certain chassis, an extra long drum retaining stud is fitted to each rear hub to prevent incorrect wheel mounting.

Refit the oil sealing gasket (or fit a new one) between the brake drum and the hub flange and then drive the brake drum gently into position by tapping **lightly** with a suitable piece of wood. Ensure that it is fully home before refitting and tightening the brake drum securing nuts or setscrews.

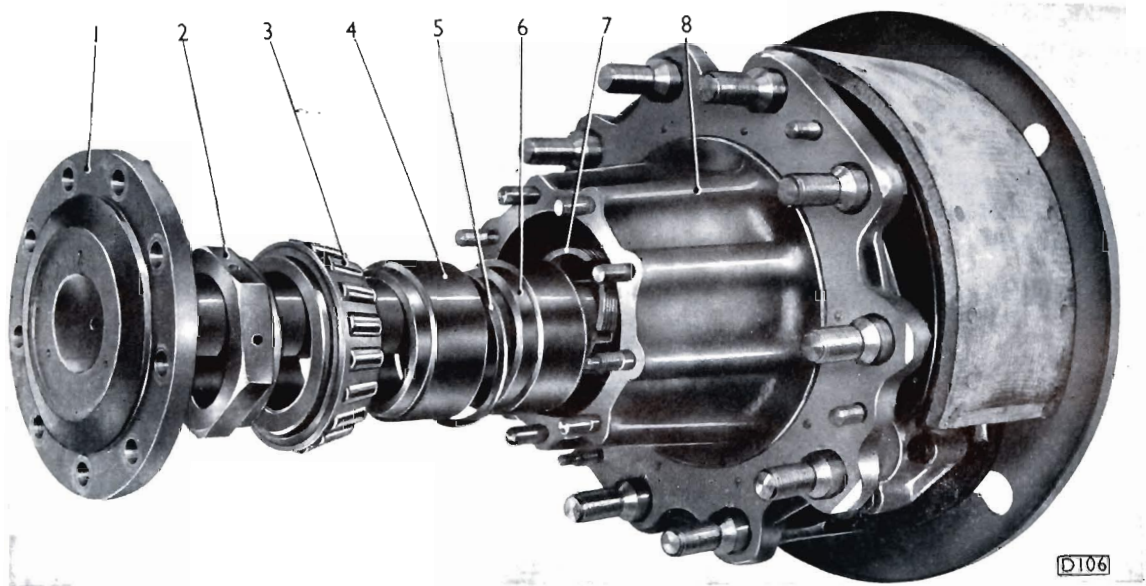
Refit the road wheel (see Part A).

Finally, re-adjust the brake (see Part K).

## Section 5

## HUBS—TO REMOVE

(See Figs. H4 and H5)

**Key to Numbers:—**

- |   |   |
|---|---|
| 1. COUPLING FLANGE INTEGRAL WITH AXLE SHAFT       | 5. SHIM   |
| 2. HUB BEARING NUT                                | 6. BEARING DISTANCE PIECE (SEE NOTE IN SECTION 6) |
| 3. OUTER HUB BEARING ROLLER ASSEMBLY              | 7. AXLE TUBE                                      |
| 4. BEARING DISTANCE PIECE (SEE NOTE IN SECTION 6) | 8. HUB  |

**Fig. H5** Rear hub details showing stud fixing for brake drums as used on early type axles

Scotch the front wheels both in front and behind.

Jack up the axle or each wheel in turn, and remove the road wheel (*see Part A*).

Remove the axle shaft (*see Section 3*).

If desired, the brake drum may be removed at this stage (*see Section 4*) or, alternatively, the hub and drum may be removed as a unit.

Remove the two locking bolts from the hub bearing nut and unscrew the nut by means of a suitable spanner.

On **early axles** the thread on the end of each axle tube is right-hand.

**Late axles** have a right-hand thread on the right-hand tube and a left-hand thread on the left-hand tube.

Withdraw the hub complete with the bearings and distance pieces, taking care that the cone and

roller assembly of the outer bearing do not fall forward out of the hub while it is being withdrawn.

Remove from the hub the cone and roller assembly of the outer bearing, and the distance pieces and shims between the bearing cones; put them in a safe place.

Remove the inner distance piece.

Should it be necessary to remove the inner bearing cone and roller assembly, or either of the bearing cups, remove the seal, circlip, and washer, then use a suitable draw dog or drive them out from the opposite end of the hub with a hammer and a suitable dolly.

If the brake operating shafts are to be removed, their location should be noted to ensure that each shaft is refitted in the same position from which it was removed, **as they are not interchangeable** (*see Part K*).

## Section 6

## HUBS AND HUB BEARINGS—TO FIT AND ADJUST

(See Figs. H4 and H5)

If the hub has been removed, or new hub bearings are being fitted, the bearings must be checked and, if necessary, re-shimmed.

The taper roller hub bearings are adjusted by selective assembly of shims placed between the two identical distance pieces (see "Note") which are fitted between the cones of the bearings. (For dimensions of shims available see Section 14).

**Note.**—On **late type** axles, the hub bearing distance pieces are of different diameters; it is most important that the larger diameter distance piece is fitted adjacent to the inner bearing.

**Never tighten the hub bearing nut without feeling for "nip" in the bearings by rotating the hub. If the hub bearing nut is fully tightened with inadequate shims, the bearings may be damaged. On the other hand, the required play in the bearings must not be obtained by slackening back the hub bearing nut. Shims of the correct thickness must be used before the hub bearing nut is fully tightened.**

The shims are selected by trial to give the hub an end play of 0.006 in. (0.152 mm.), which is equivalent to just a perceptible amount of rock on the hub, when the hub bearing nut is tightened to clamp firmly together the two bearing cones, the two distance pieces and the shims.

To obtain the correct combination of shims, assemble and fit the hub by reversing the procedure given in Section 5, but **without the seal and without lubricant**.

Tighten the hub bearing nut cautiously, meanwhile rotating the hub by hand. If the bearings just "nip" when the bearing nut is fully tightened, the correct shims will have been fitted.

Dismantle the hub assembly and lubricate it as follows:—

Pack with grease the cup and the cone assemblies of the taper roller bearings, also apply a light film of grease to the internal faces of the hub.

**Do not pack the hub cavity or the hub cap with grease**, but lightly coat the stub axle and the internal face of the hub sufficiently with grease to prevent corrosion.

Smear the working surface of the lip type seal and fit the seal with the lip pointing towards the bearings (for specification of grease see Part S).

Reassemble the hub, **adding a shim 0.006 in. (0.152 mm.) thick to the shims already fitted.**

The added shim will give the required end play of 0.006 in. (0.152 mm.).

When the hub bearing nut is fully tightened, fit and secure it with the two locking bolts.

It is **most important** when changing from one type of grease to another, that all the old grease is removed before introducing the new.

Greasing between overhauls is not required and, on early hubs fitted with a lubricator, it is recommended that the lubricator is removed and exchanged for a plug.

## Section 7

## REDUCTION GEAR AND DIFFERENTIAL ASSEMBLY—TO REMOVE AND FIT

(See Figs. H1 and H5)

### To Remove

The reduction gear and differential assembly can be withdrawn without removing the axle from the chassis, as follows:—

Drain the oil from the axle (see Section 2).

Remove the axle shafts (see Section 3).

Disconnect the propeller shaft coupling flange at the rear axle end and tie the shaft to some convenient point to prevent damage.

Remove any pipes attached to the reduction gear casing.

Remove the nuts securing the reduction gear casing to the axle casing.

Place a suitable lifting tackle in position and attach the hook to the lifting eye on the reduction gear casing, then take the weight of the assembly.

Screw two  $\frac{1}{2}$  in. B.S.F. setscrews into the tapped holes in the differential casing flange and, by tightening the setscrews evenly in succession, draw the unit off the dowels which locate it in the axle casing. Lift the assembly out of its register and lower it to the ground.

#### To Fit

Ensure that the mating flange faces and the

dowels which locate the reduction gear casing with the axle casing, are clean and free from burrs.

Fit a new joint between the reduction gear casing and the axle casing but do not use sealing compound.

Fit the reduction gear to the axle casing by reversing the procedure for removal, then fit the flange nuts and spring washers and tighten down evenly to a torque loading of 85 lb. ft. (11.7 k.g.m.)

Connect the propeller shaft universal joint flanges and fit the axle shafts (*see Section 3 and Part E*).

Finally, fill the axle with oil to the level of the filler plug hole (*see Part S*).

## Section 8

### REDUCTION GEAR AND DIFFERENTIAL ASSEMBLY—TO DISMANTLE

(*See Figs. H1, H6, H7 and H8*)

#### To Remove the Differential Assembly

Invert the reduction gear assembly on the bench, stabilizing it by blocks on each side or, if available, hold it in a suitable fixture.

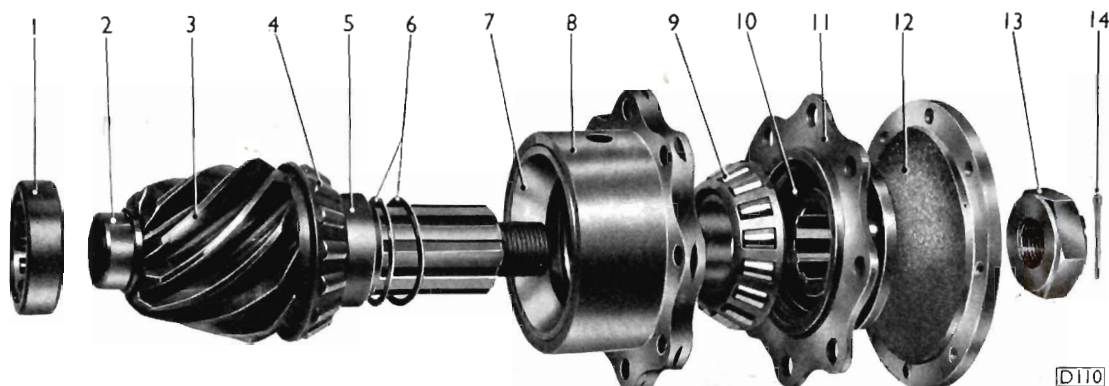
Withdraw the split pins and remove the bearing adjusting nut locking plates.

Break the bearing cap setbolt locking wire (when fitted). Mark the bearing cap setbolts to

ensure that they are fitted to the same holes when assembling, also see that the bearing caps are marked to locate their relative positions, then unscrew the bearing cap setbolts and remove the caps.

Remove the bearing adjusting nuts.

Lift out the differential assembly.



#### Key to Numbers:—

1. OUTER RACE OF SPIGOT ROLLER BEARING
2. INNER RACE OF SPIGOT ROLLER BEARING
3. BEVEL PINION SHAFT
4. INNER BEARING ROLLER ASSEMBLY
5. BEARING DISTANCE PIECE
6. SHIMS
7. BEARING CUP

8. BEARING HOUSING
9. OUTER BEARING TAPER ROLLER ASSEMBLY
10. OIL SEAL
11. OIL SEAL HOUSING
12. COUPLING FLANGE
13. COUPLING FLANGE RETAINING NUT
14. SPLIT PIN

Fig. H6 Exploded view of bevel pinion assembly (early type)



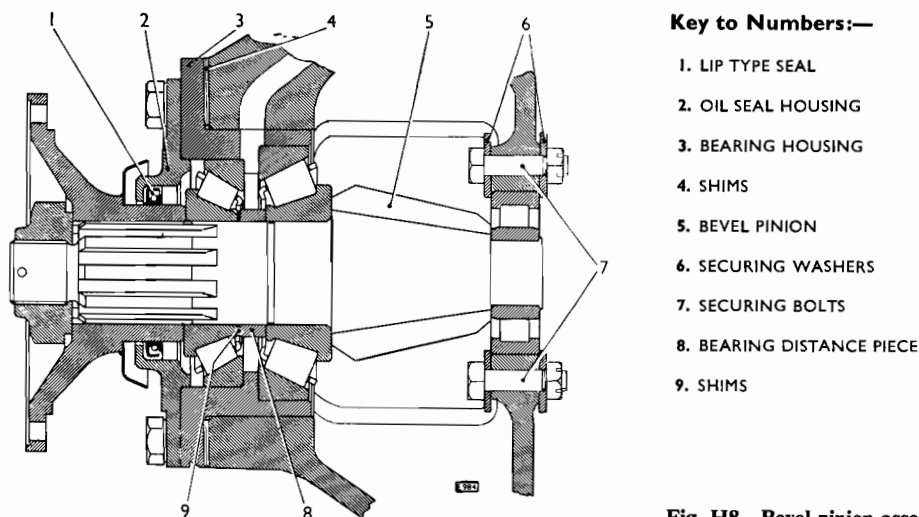
If required, the cups can be driven from the bearing housing using a hammer and brass drift.

Draw off the inner race of the bevel pinion spigot bearing.

**Early chassis.**—If the bevel pinion spigot bearing

is to be removed, drive out the outer race from the reduction gear casing.

**Late chassis.**—Before the outer race of the bevel pinion spigot bearing can be driven from the reduction gear casing, the two securing bolts and four washers must be removed (*see Fig. H8*).



**Key to Numbers:—**

1. LIP TYPE SEAL
2. OIL SEAL HOUSING
3. BEARING HOUSING
4. SHIMS
5. BEVEL PINION
6. SECURING WASHERS
7. SECURING BOLTS
8. BEARING DISTANCE PIECE
9. SHIMS

**Fig. H8 Bevel pinion assembly (late type)**

## Section 9

# REDUCTION GEAR AND DIFFERENTIAL ASSEMBLY—TO ASSEMBLE

(*See Figs. H1, H6, H7 and H8*).

The method of assembling the reduction gear and differential assembly is clearly shown in Figures H6 and H7.

All parts should be examined for wear and replacements made where necessary.

Ensure that all oilways and grooves are free from obstruction.

The following points should receive particular attention:—

When assembling the bevel wheel to the differential casing, see that the locating marks on the wheel and casing are in line. The torque spanner loading for the bevel wheel retaining setbolts is 120 to 130 lb. ft. (16.5 to 18.0 kg.m.).

The halves of the differential casing are matched in pairs when machined and are marked with a number on each half; it is essential that they are always assembled with the location marks in line (*see Fig. H7*).

When assembling a differential spider into a new

casing supplied as spares, it is necessary to file a small radius along the outer edge of the recesses into which the spider arms fit. This enables the arms of the spider to bed down on the bearing surfaces (*see Fig. H7*).

The differential bevel wheels are made a free fit in the casing in order to equalize the drive to all four bevel pinions.

**Note:**—If differential bevel wheels or bevel pinions are to be renewed they should be fitted as a complete set.

See that the slot in each thrust washer is correctly located on the dowel in the lipped half of the differential casing and that there is backlash between the teeth of the bevel wheels and the bevel pinions before placing the other half of the casing in position.

The differential bearings should be adjusted before finally tightening the bearing caps (*see Section 12*).

## Section 10

## BEVEL PINION SHAFT AND BEARINGS

## —TO ASSEMBLE AND ADJUST

(See Figs. H6, H8 and H9)

To determine the correct preload on the pinion shaft bearings, assemble the pinion shaft by reversing the procedure given for dismantling (see Section 8), **but omitting the seal and its housing**.

Ensure that the shims are fitted between the bearing spacer and the outer bearing (see Section 8). (For dimensions of shims available see Section 14).

Fit the coupling flange and tighten the retaining nut. The bearing housing should be turned by hand whilst the nut is being tightened, and a noticeable "drag" should be felt when the nut is tight.

To check the torque proceed as follows:—

Clamp the coupling flange in a vice.

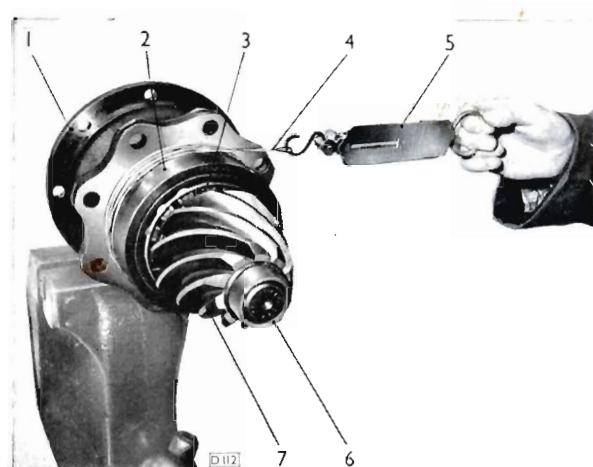
Wrap a length of cord or soft wire around the outside diameter of the bearing housing. Attach one end to the flange of the housing and the free end to a suitable spring balance similar to that shown in Figure H9.

Pull on a line tangential to the outside of the bearing housing and check the reading on the spring balance.

**On early chassis** the bearing housing radius is  $2\frac{1}{2}$  in. (63.5 mm.) and the reading on the spring balance should be 6 lb. (2.7 kg.) to give the required torque of 15 lb. in. (17.3 kg. cm.).

**On late chassis** the bearing housing radius is  $2\frac{3}{4}$  in. (70 mm.) and the reading on the spring balance should be 3 to  $5\frac{1}{2}$  lb. (1.36 to 2.5 kg.) to give the required torque of 8 to 15 lb. in. (9.1 to 17.3 kg. cm.).

The bearing housing should be turning steadily when the reading is taken, as the starting torque will be higher than the running torque.



## Key to Numbers :—

- |                               |                                 |
|-------------------------------|---------------------------------|
| 1. COUPLING FLANGE            | 4. CORD OR SOFT WIRE            |
| 2. BEARING HOUSING            | 5. SPRING BALANCE               |
| 3. INNER TAPER ROLLER BEARING | 6. INNER RACE OF SPIGOT BEARING |
|                               | 7. BEVEL PINION                 |

Fig. H9 Method of checking torque when preloading bevel pinion bearings

If the torque is not within the required limits, the assembly should be dismantled and the shims changed, i.e., add shims to decrease torque and vice versa. Repeat this operation until the correct torque is obtained.

Remove the coupling flange and fit the seal in the housing with the lip pointing towards the bearings. Fit the housing complete with seal and joint, using non-hardening jointing compound. When refitting the flange, the retaining nut should be tightened to a torque loading of 320 to 400 lb. ft. (44.2 to 55.2 kg. m.); split pin the nut.

**Note.**—If the spigot bearing on the bevel pinion shaft has been removed or is to be renewed, the inner race must be pressed on and secured by peening over the end of the pinion shaft in not less than four places.

## Section 11

## BEVEL PINION SHAFT ASSEMBLY—TO FIT

(See Fig. H10)

**Early chassis.**—If the spigot bearing on the bevel pinion shaft has been removed or is to be renewed, the outer race must be driven into the

reduction gear casing before the differential assembly is fitted.

**Late chassis.**—If the spigot bearing on the bevel pinion shaft has been removed or is to be renewed, the outer race must be driven into the reduction gear casing and located with the securing bolts and washers before the differential assembly is fitted (*see Fig. H8*).

After setting the preload on the bevel pinion shaft bearings (*see Section 10*), the bevel pinion shaft must be positioned in the reduction gear casing so that correct meshing with the bevel wheel can be obtained. This position is obtained by shimming between the bevel pinion shaft bearing housing and the reduction gear casing.

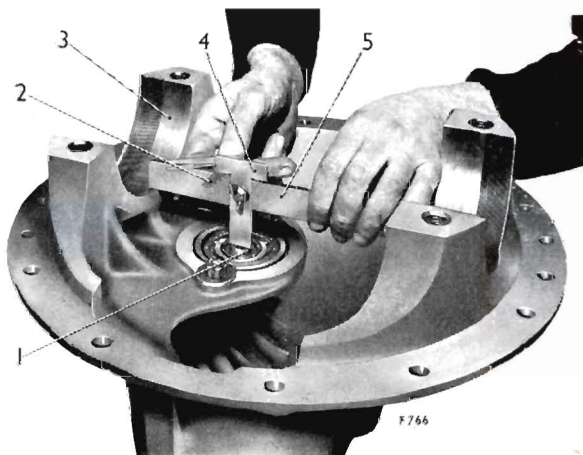
The thickness of shims required can be determined by one of the following methods:—

#### **Bar and Slide Method** (*see Fig. H10*)

Fit the pinion assembly to the bevel casing.

Use the gauge listed in the Maintenance Equipment.

Slacken the slide wingnut and place the bar of the gauge on the bottom of the bearing bores. Find a position for the slide at which the tip of the slide just touches the surface of the pinion spigot when moved over it and tighten the wingnut in this position.



**On early vehicles** (pinions with an annular groove machined in face of spigot). Insert feeler gauges in the gap between the top of the bar and the underside of the slide, and fit shims equal to this gap between the bearing housing flange and the bevel casing.

**On late vehicles** (pinions without annular groove). As these pinions have a  $\frac{3}{16}$  in. (4.76 mm.) longer spigot for the spigot bearing, it will be necessary to fit a  $\frac{3}{16}$  in. (4.76 mm.) thick distance piece in the gap between the top of the bar and underside of the slide before assessing the thickness of shims required.

#### **Gauge Setting Block Method** (*see Fig. H11*)

Mount the spiral bevel pinion assembly, driving flange downwards, on to three equally spaced jacking screws fitted to a base plate.

Adjust the jacking screws and, using the dial indicator, set the assembly square with the base plate.

Place the setting block listed in the Maintenance Equipment (marked 2.473 in.), on the locating face of the pinion bearing flange.

With the dial indicator standing on the base plate, place the stylus of the indicator against face "C" (the top of the setting block) and adjust the gauge to zero.

#### **Key to Numbers:—**

- 1. BEVEL PINION SPIGOT
- 2. FEELER GAUGE
- 3. DIFFERENTIAL BEARING BORE
- 4. GAUGE SLIDE
- 5. GAUGE BAR

**Fig. H10** Method of determining thickness of shims for positioning the spiral bevel pinion

Now place the stylus against face "D" (face of bearing cone) and read off the height difference "A" (between the faces).

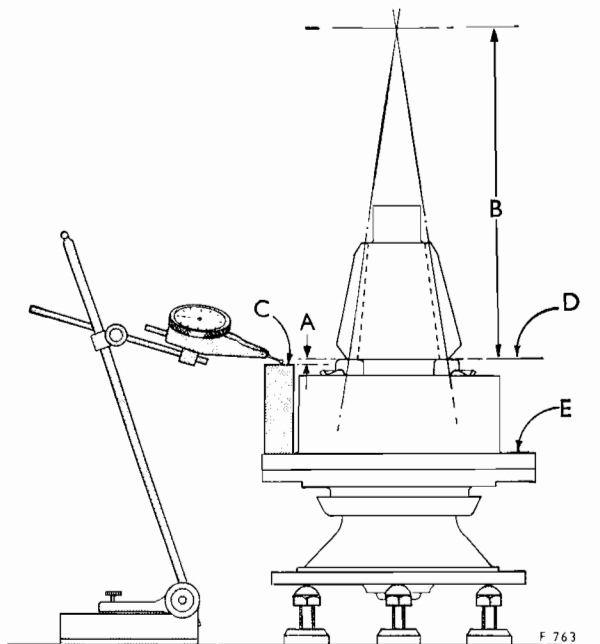
If the reading is positive i.e. the face of the bearing cone is **higher** than the face of the setting block, **add** it to the setting block dimension, but if it is negative, i.e. the face of the bearing cone is **lower** than the face of the setting block, **subtract** it from the setting block dimension.

Add the resultant figure to dimension "B" (8.125 in. nominal) plus or minus the variation figure indicated on the rear angular face of the pinion teeth, but, on certain pinions the variation is marked either on the end face of the pinion spigot, or on the pinion splines; then subtract the resultant dimension from the dimension indicating the overall length of the reduction gear casing: this will be found stamped on a raised pad on the casing.

The final dimension obtained will indicate the correct thickness of shims.

A typical example of this method of working is shown herewith:—

Setting block dimension .. ..	2.473 in.
Height (difference between faces "C" and "D" = A) .. ..	0.007 in.
Dimension "B" (nominal) .. ..	8.125 in.
Variation marked at end of pinion .. .. .	0.008 in.
	<hr/>
	10.613 in.
Dimension stamped on casing ..	10.532 in.
	<hr/>
Thickness of shims .. ..	0.081 in.
	<hr/>



**Key to Letters:—**

"A" DIMENSION—HEIGHT DIFFERENCE BETWEEN FACES "C" AND "D"

"B" DIMENSION—8.125 in. (NOMINAL)

"C"—MEASURING FACE—TOP OF SETTING BLOCK

"D"—MEASURING FACE—PINION SHAFT INNER BEARING

"E"—SHIMS TO BE PLACED HERE

Fig. H11 Method of determining thickness of shims for positioning the spiral bevel pinion

## Section 12

## DIFFERENTIAL BEARINGS—TO ADJUST

(See Fig. H13)

The bevel pinion shaft must not be fitted in the reduction gear casing while this operation is being carried out.

To determine the correct preload on the differential bearings, fit the differential assembly into the

reduction gear casing, reversing the procedure given for dismantling (see Section 8), but do not fully tighten the bearing cap setbolts at this stage. Ensure that the bearing caps and setbolts are fitted in their correct positions (see Section 8).

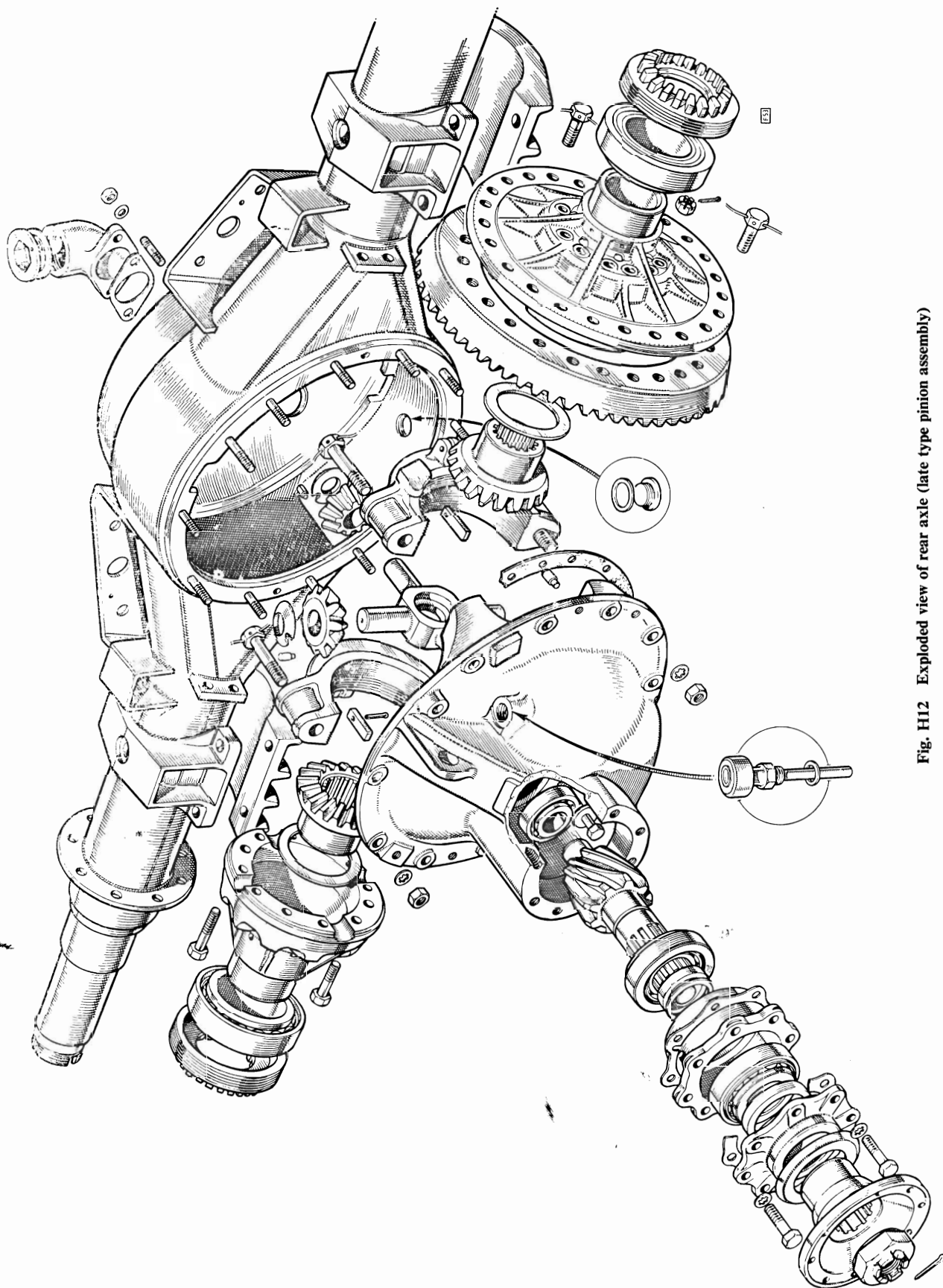


Fig. H12 Exploded view of rear axle (late type pinion assembly)

Secure the flange of the reduction gear casing to a fixture or in a vice.

Tighten the bearing adjusting nuts evenly, meanwhile turning the bevel wheel by hand, until a noticeable "drag" is felt, then tighten the bearing cap setbolts.

**Note:**—The differential bearing cap setbolts should be tightened to a torque spanner loading of 220 lb. ft. (30.4 kg. m.).

There is no "draw" on the differential bearing caps; the casing is bored after the caps have been tightened down with the setbolts to the required torque figure.

To check the torque proceed as follows:—

Wrap a length of cord or soft wire around the outside diameter of the differential casing, and attach the free end to a suitable spring balance, similar to that shown in Figure H13.

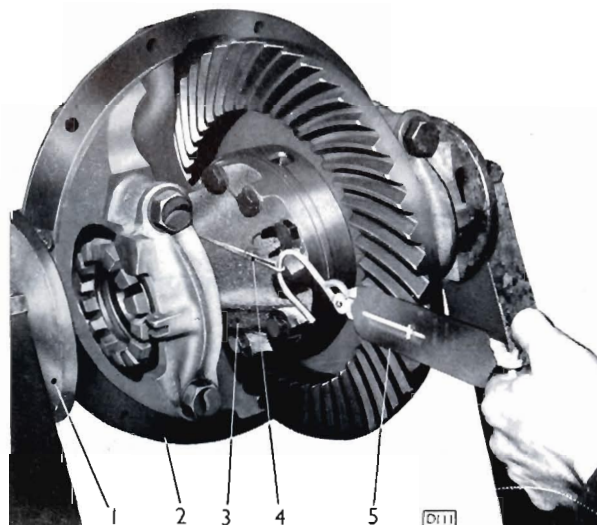
Pull at a tangent to the outside of the differential casing and check the reading on the spring balance. As the radius of the differential casing, taken from the centre line of the axle, is 2 in. (50.8 mm.), the reading on the spring balance should be between  $7\frac{1}{2}$  and 10 lb. (3.4 and 4.5 kg.) to give the required torque of between 15 and 20 lb. in. (17.3 and 23.00 kg. cm.).

The differential casing should be turning steadily when the reading is taken, as the starting torque will be higher than the running torque.

If the torque is not within the required limits, slacken the bearing cap setbolts sufficiently to

allow the adjusting nut to be turned, then tighten the adjusting nut if a higher torque is required or vice versa.

The bearing cap setbolts must be tightened to the required torque spanner loading before each trial.



**Key to Numbers:—**

- |   |                        |
|---|------------------------|
| 1. FIXTURE FOR HOLDING<br>REDUCTION GEAR UNIT | 3. DIFFERENTIAL CASING |
| 2. REDUCTION GEAR CASING                      | 4. CORD OR SOFT WIRE   |
|   | 5. SPRING BALANCE      |

**Fig. H13** Method of checking torque when preloading differential bearings

## Section 13

### BEVEL WHEEL—TO ADJUST FOR BACKLASH AND FINAL CHECK

(See Fig. H14 and H15)

#### To Adjust for Backlash

When the operations described in Sections 9 to 12 inclusive have been completed, it is only necessary to move the bevel wheel to secure the correct backlash.

**As all backlash is obtained by adjusting the bevel wheel, do not attempt to obtain this by altering the bevel pinion setting, this must not be disturbed (see Section 11).**

To adjust the backlash move the bevel wheel in or out of mesh with the pinion as required by using the following procedure.

Ensure that the bearing cap setbolts are loosened sufficiently to allow sideways movement of the differential bearings, and that each bearing adjusting nut is marked in relation to its bearing cap.

This marking will allow observation of the

relative movement of each nut to its cap, to ensure that if one nut is adjusted the other nut is also adjusted an equal amount, thus retaining the preload on the bearings.

Adjust the nuts as required until the pinion and wheel are correctly meshed and revolve freely without any hard spots, and with a backlash of 0.008 in. to 0.011 in. (0.203 mm. to 0.279 mm.), measured normal to the bevel wheel teeth near the outside diameter with a dial indicator (see Fig. H14).

When finally adjusted, tighten the bearing cap setbolts to the torque loading shown in Section 12, and, if the heads are drilled, add the locking wire.

### Final Check

The method of checking the adjustment is as follows:—

Coat the teeth of the bevel pinion with a thin layer of marking compound.

Turn the pinion until the bevel wheel has made a complete rotation both forward and backward, the wheel being retarded with the hand meanwhile to ensure a good marking.



Fig. H14 Method of measuring backlash with a dial indicator

The contact marking thus obtained on the teeth should be as shown in Figure H15.

**Note:**—When subjected to full load, slight deflections will result in the contact markings extending to the full length of the tooth sides.

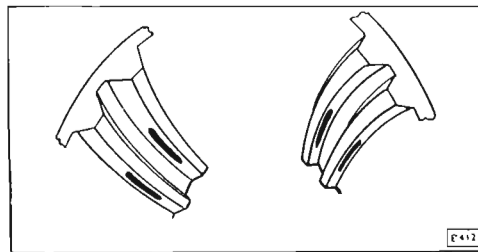


Fig. H15 Correct contact markings on sides of bevel wheel teeth under "hand load" only

L.H. view—drive side of tooth

R.H. view—overrun side of tooth

**Section 14****DIMENSIONS OF SHIMS AVAILABLE**

Alternative shims, listed hereunder, are supplied to enable correct clearances to be obtained during assembly. Refer to the "Spare Parts Catalogue" for part numbers.

Part	Width or Thickness
Shim—Hub Taper Roller Bearing	{ <ul style="list-style-type: none"> <li>0·050 in. (1·27 mm.)</li> <li>0·030 in. (0·76 mm.)</li> <li>0·012 in. (0·30 mm.)</li> <li>0·006 in. (0·15 mm.)</li> </ul>
Shim—Bevel Pinion Shaft Taper Roller Bearings	{ <ul style="list-style-type: none"> <li>0·012 in. (0·30 mm.)</li> <li>0·013 in. (0·33 mm.)</li> <li>0·030 in. (0·76 mm.)</li> <li>0·020 in. (0·51 mm.)</li> <li>0·015 in. (0·38 mm.)</li> <li>0·017 in. (0·43 mm.)</li> </ul>
Shim—Bevel Pinion Bearing Housing	{ <ul style="list-style-type: none"> <li>0·002 in. (0·05 mm.)</li> <li>0·003 in. (0·08 mm.)</li> <li>0·010 in. (0·25 mm.)</li> <li>0·030 in. (0·76 mm.)</li> </ul>

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H18

## NOTES

## NOTES

H20

## NOTES

# PART J47

## SUSPENSION

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## Section 1

## FRONT SUSPENSION

(See Fig. J1)

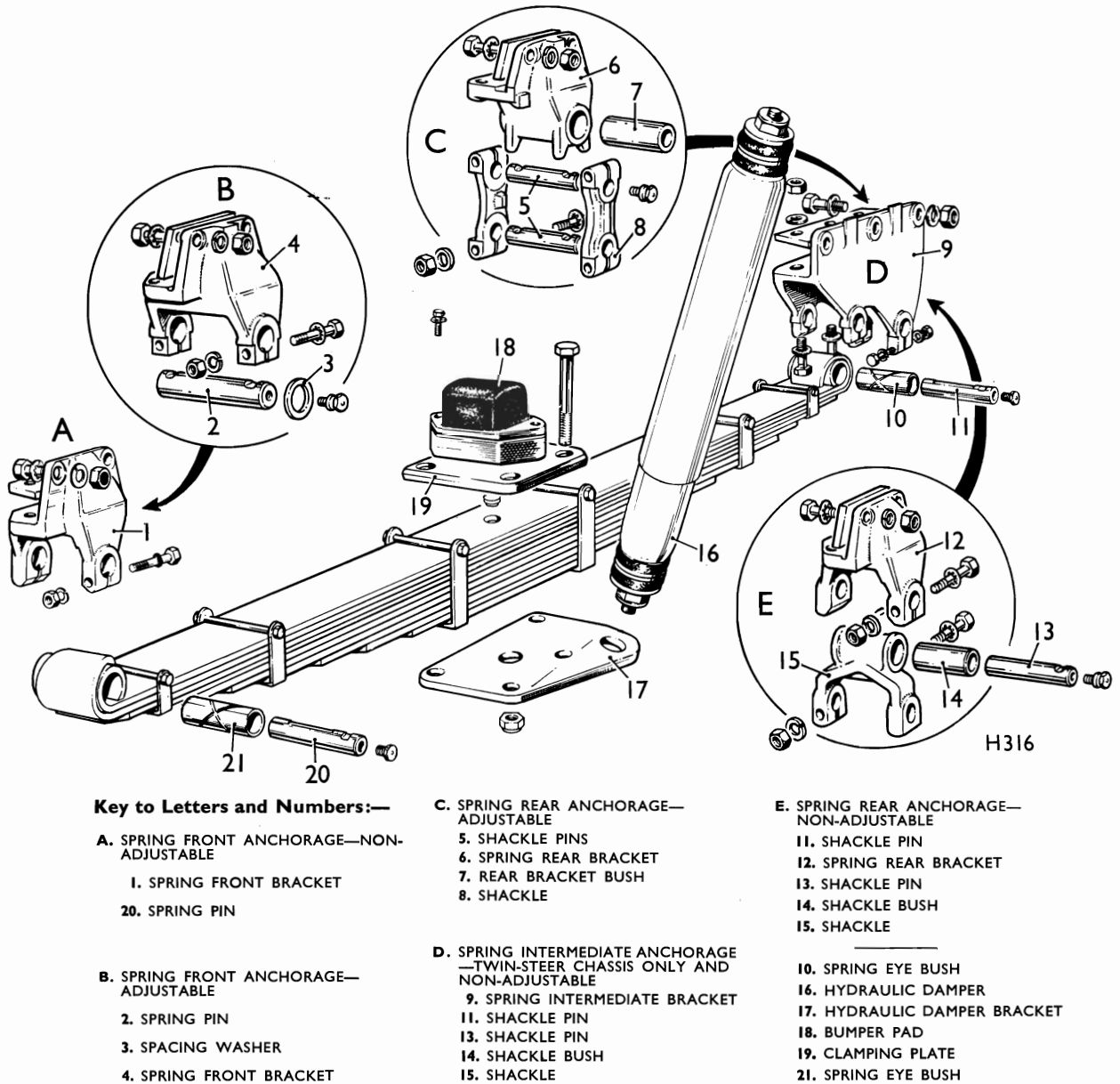


Fig. J1 Front spring anchorage

## Spring Pins and Shackle Pins

## To Remove

Apply the parking brake.

Jack up the **frame** to take the load off the spring.

Remove the lubricator or the lubrication pipe from the end of the pin to be withdrawn.

Slacken the clamp bolt nut(s) on the spring or shackle pin and, using a hammer and a suitable soft metal drift, tap the end of the pin to free the clamp bolt(s).

Withdraw the pin by using the appropriate tool listed in the Maintenance Equipment, retaining the spacing washer (when fitted) located between the spring eye and the front spring bracket.

**Note:—**If the pin has worn excessively it may be necessary to manoeuvre the spring in order to align the shackle and spring eye or bracket (shackle pins), or the spring eye and bracket (spring pins), to facilitate withdrawal.

### To Fit

Examine the pin for wear and replace, if necessary.

Similarly, examine the spacing washer (when fitted) for wear and, if necessary, renew.

Lubricate and insert the pin, using the appropriate tool listed in the Maintenance Equipment. Fit the clamp bolt(s) ensuring that the holes are in line with the groove(s) in the pin.

When applicable, adjust the spring for side play as instructed under "**Springs—To Adjust**" and then ensure that the spring or shackle pin lubrication holes are clear by giving the pin a liberal charge of lubricant; the lubricant should discharge from around the pin.

### Springs

#### To Remove

Apply the hand brake.

Jack up the **frame** to take the load off the spring.

Remove the spring and shackle pins as previously described.

Disconnect the hydraulic damper from its lower bracket.

Remove the spring securing bolts; to ease removal of these bolts it may be found necessary to jack up the axle beam and remove the road wheel.

Note the position of the spring clamping plate and spring relative to the chassis and lift the spring off the axle beam.

#### To Fit

Reverse the procedure for removal noting the following points:—

Ensure that the spring locating dimple seats correctly in the hydraulic damper mounting bracket and that the bracket dimple seats correctly on the axle beam.

Similarly, ensure that the spring clamping plate locating dowel seats correctly in the plate and the spring.

Check that the heads of the securing bolts sit squarely on the clamping plate.

Fit the spring and shackle pins as previously described.

When applicable, adjust the springs for side play as described under "**To Adjust**" and then ensure that the spring and shackle pin lubrication holes are clear.

Ensure that the tyres do not foul the spring clips or any part of the chassis when the wheels are in their full lock position. If necessary, adjust the steering stop setscrews on the axle (*see Part F*).

#### To Adjust

##### Spring Pins

**Note:**—There are two types of spring front anchorage employed, one having a spacing washer fitted between the spring eye and bracket for side play

adjustment, the other type having no spacing washer and, therefore, non-adjustable.

The **adjustable type** should be checked as follows:—

Remove the lubricator or disconnect the lubrication pipe and remove the clamp bolts from the spring bracket.

Drive the pin inwards towards the centre of the vehicle sufficiently to allow the spacing washer to be removed.

Fit a new spacing washer, if necessary, to give 0.040 in. (1 mm.) side play between the spring eye and bracket (*see Section 6 for the thickness of washers available*). Drive the pin back into position and fit the clamp bolts, ensuring that the holes are in line with the grooves in the pin.

##### Shackle Pins

**Note:**—There are two types of shackle pin fitted, one being of the adjustable type, the other being non-adjustable. The two types are easily identified as the **adjustable type** has two clamp bolt grooves, the groove at the lubricator end being elongated to permit side movement of the shackle and clamp bolt; this pin is secured by clamp bolts at both ends. The **non-adjustable type** has a single clamp bolt groove at the lubricator end, its opposing end being plain; a single bolt secures this pin.

The **adjustable type** should be adjusted as follows:—

Slacken the clamp bolts on the **outer** shackle and tap the shackle pin until there is 0.040 in. (1 mm.) clearance between the shackle and the spring eye or the spring bracket; then tighten the clamp bolts.

Finally, tap the ends of the pins in order to equalise the clearance at either side of the spring eye.

### Hydraulic Dampers

#### To Remove

Remove the locknuts securing the hydraulic damper to its brackets.

Compress the damper and lift it clear of the brackets.

#### To Test

With suitably protected jaws fitted to a vice to protect the lower mounting stud, clamp the unit in the upright position.

Work the damper through the full length of its stroke noting that the resistance felt should be uniform throughout; free or erratic motion denotes a defective unit.

If the damper is found to be defective it should be returned to any AEC Depot or Agent and a new unit obtained in exchange.

#### To Fit

Ensure that the mounting bushes are in good condition and reverse the procedure given for removal.

## Section 2

## TWO SPRING REAR SUSPENSION

(See Fig. J2)

### Spring Pins and Shackle Pins

#### To Remove

Chock the **front** wheels in front and behind before removing the pins from the rear road springs.

Jack up the **frame** to support the weight of the vehicle.

Remove the lubricator or lubrication pipe from the end of the pin to be withdrawn.

Slacken the clamp bolt nuts on the spring or shackle pins and, using a hammer and a suitable soft metal drift, tap the end of the pin to free the clamp bolts.

Remove the clamp bolts.

Withdraw the pin using the appropriate tool listed in the Maintenance Equipment, retaining the spacing washer (when fitted) located between the spring eye and the front spring bracket.

To remove the **upper** shackle pin it is necessary to gain access to the clamp bolt through the two apertures in the rear spring bracket. If the clamp bolt head does not come truly opposite the aperture, first remove the lower shackle pin, then rotate the upper pin by tapping the shackle until the upper bolt head is accessible to a box spanner.

**Note:**—If the pin has worn excessively it may be necessary to manoeuvre the spring in order to align the shackle and spring eye or bracket (shackle pin) or the spring eye and bracket (spring pin) to facilitate withdrawal.

#### To Fit

Examine the pin for wear and replace, if necessary.

Similarly, examine the spacing washer (when fitted) for wear and, if necessary, renew.

Lubricate and insert the pin, using the appropriate tool listed in the Maintenance Equipment.

Fit the clamp bolts, ensuring that the holes are in line with the grooves in the pin.

Adjust the spring for side play as instructed under "**Springs—To Adjust**" and then ensure that the spring or shackle pin lubrication holes are clear by giving the pin a liberal charge of lubricant; the lubricant should discharge from around the pin.

Lower the frame and remove the chocks from under the front wheels.

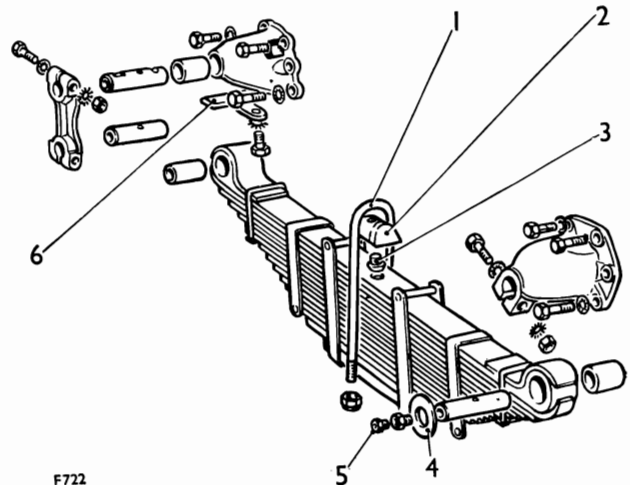
### Springs

#### To Remove

Chock the **front** wheels in front and behind.

Jack up the **frame** to take the load off the spring.

Remove the spring and shackle pins as previously described.



#### Key to Numbers:—

- |   |   |
|---|---|
| 1. SPRING SECURING "U" BOLT (see Section 3) | 4. SPACING WASHER                         |
| 2. SPRING SADDLE                            | 5. LUBRICATOR—SPRING PIN AND SHACKLE PINS |
| 3. SPRING LOCATING DOWEL                    | 6. SHACKLE STOP BRACKET (WHEN FITTED)     |

Fig. J2 Typical rear spring anchorage

To ease removal of the spring securing "U" bolts it may be necessary to jack up the spring carrier and remove the roadwheels.

Remove the nuts from the "U" bolts, withdraw the bolts and detach the saddle from the spring.

Note the position of the spring relative to the chassis and remove the spring, complete with the "helper" spring (when fitted).

#### To Fit

Reverse the procedure for removal noting the following points:—

Ensure that the spring locating dimple seats correctly on the axle spring carrier and that the saddle locating dowel seats correctly in the saddle and the spring.

Check that the "U" bolts sit squarely in their grooves in the saddle and fit the nuts, tightening evenly and in sequence.

Fit the spring and shackle pins as previously described.

When applicable, adjust the springs for side play as described under "**To Adjust**" and then ensure that the spring and shackle pin lubrication holes are clear.

Remove the chocks from under the front wheels.

### To Adjust Spring Pins

On certain chassis a spacing washer is fitted between the spring eye and spring bracket; adjustment for side play is as follows.

Remove the lubricator or disconnect the lubrication pipe and remove the clamp bolts from the spring bracket.

Drive the pin inwards, towards the centre of the vehicle sufficiently to allow the spacing washer to be removed or, if necessary withdraw the pin as previously described.

Fit a new spacing washer, if necessary, to give 0.040

in. (1 mm.) side play between the spring eye and bracket (*see Section 6 for thickness of washers available*). Drive the pin back into position and fit the clamp bolts ensuring that the holes are in line with the grooves in the pin.

### Shackle Pins

Remove the lubricator or disconnect the lubrication pipe and slacken the clamp bolts on the **outer** shackle.

Tap the shackle until there is 0.040 in. (1 mm.) clearance between the shackle and the spring eye and the spring bracket, then tighten the clamp bolts.

Finally, tap the ends of the pin in order to equalise the clearance at either side of the spring.

## Section 3

## BALANCE BEAM BOGIE REAR SUSPENSION

(See Figs. J3, J4 and J5)

### To Remove

#### Spring Pins and Shackle Pins

Chock the **front** wheels in front and behind before removing the pins from the rear road springs.

Jack up the **frame** to support the weight of the vehicle.

Remove the lubricator, or lubrication pipe (when fitted) from the pin to be withdrawn.

#### Spring Pins

Slacken the clamp bolt nuts and, using a hammer and a suitable soft metal drift, tap the end of the pin to free the clamp bolts.

Remove the clamp bolts.

Withdraw the pin using the appropriate tool listed in the Maintenance Equipment. Retain the spacing

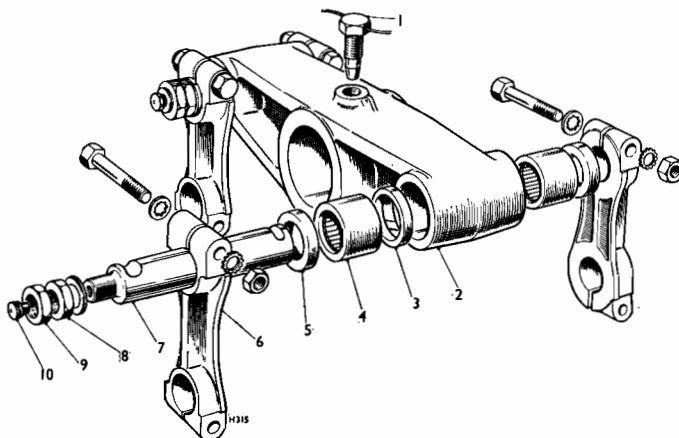
washer (when fitted) located between the spring eye and bracket.

**Note:**—If the pin has worn excessively it may be necessary to manoeuvre the spring in order to align the spring eye and bracket to facilitate withdrawal.

### Shackle Pins

**On chassis fitted with plain ended shackle pins,** remove the clamp bolt nuts and, using a hammer and a suitable soft metal drift, tap the end of the pin to free the clamp bolts and remove the bolts.

**On chassis fitted with threaded adjustable shackle pins,** remove the locknut, then slacken the adjusting nut a few turns and tap the pin with a lead hammer to free the clamp bolts; remove the adjusting nut and clamp bolts from the pin.



### Key to Numbers:—

1. BALANCE BEAM DOWEL
2. BALANCE BEAM
3. SPACER (Fitted with Needle Roller Bearing)
4. NEEDLE ROLLER BEARING or BUSH  
When shackle pin bushes are fitted, there is also a spacer between the shackle and balance beam.
5. SEAL
6. SPRING SHACKLE
7. SHACKLE PIN
8. ADJUSTING NUT
9. LOCKNUT
10. LUBRICATOR

**Fig. J3 Balance beam shackle assembly**

Place a jack under the balance beam end of the spring and, using the appropriate withdrawal tool listed in the Maintenance Equipment, withdraw the **lower** shackle pin.

**Note:**—If the pin has worn excessively it may be necessary to manoeuvre the spring in order to align the spring eye and shackle to facilitate withdrawal.

Withdraw the **upper** shackle pin from the beam end and, if necessary, remove the oil seals, and when applicable, the caged needle roller bearings and bearing spacer or alternatively, the bushes from the beam.

Retain the spacing washers (when fitted) between the beam ends and the spring shackles.

### To Fit

Examine each pin for wear and replace, if necessary.

Similarly, examine the spacing washer (when fitted) and, if necessary, renew.

Check the oil seals, needle roller bearings and spacer or bushes for wear and renew, if necessary. Ensure that the **stamped** ends of the bearings face **outwards** and that the lips of the seals face **outwards** with a clearance of approximately  $\frac{1}{8}$  in. (1.52 mm.) between the seal and the end of the bore.

Lubricate and insert the pin, using the appropriate tool listed in the Maintenance Equipment. Ensure that the clamp bolt holes are in line with the grooves in the pin and fit the clamp bolts.

Adjust the spring for side play as instructed under "**Springs—To Adjust**" and then ensure that the spring or shackle pin holes are clear by giving the pin a

liberal charge of lubricant; the lubricant should discharge from around the pin.

Lower the frame and remove the chocks from under the front wheels.

## Springs

### To Remove

Chock the **front** wheels in front and behind.

Remove the lubricators or lubrication pipes from the spring and shackle pins.

Jack up the **frame** to take the load off the spring.

Slacken the wheel nuts, jack up the axle and remove the wheels.

**Note.**—On certain chassis the springs are secured by clamping plates and bolts, alternative to the "U" bolt and saddle shown in Figure J2.

Remove the nuts from the securing bolts, withdraw the bolts and detach the saddle or plates from the spring.

Place a jack under the balance beam end of the spring and, using the appropriate tool listed in the Maintenance Equipment remove the **lower** shackle pin. Lower the spring carefully and remove the jack.

Supporting the spring and using the appropriate tool listed in the Maintenance Equipment, remove the spring pin from the anchorage bracket. Note the position of the spring in relation to the vehicle, then lower and remove from beneath the chassis.

Retain the packing pieces (when fitted) between the springs and the trailing axle pads.

### Key to Numbers:—

1. SPRING SHACKLE STOPS
2. SEAL COLLAR
3. BALANCE BEAM BRACKET
4. SHACKLE PIN LUBRICATOR ADAPTOR
5. ANCHOR PLATE SPRING CLIP
6. LUBRICATOR—SPRING SHACKLE PIN
7. SPRING SHACKLE
8. LUBRICATOR—BALANCE BEAM BEARINGS
9. BALANCE BEAM BEARING OUTER COVER
10. SHIMS—BALANCE BEAM BEARING OUTER COVER
11. SPRING SHACKLE CLAMP BOLT
12. BALANCE BEAM
13. BALANCE BEAM DOWEL

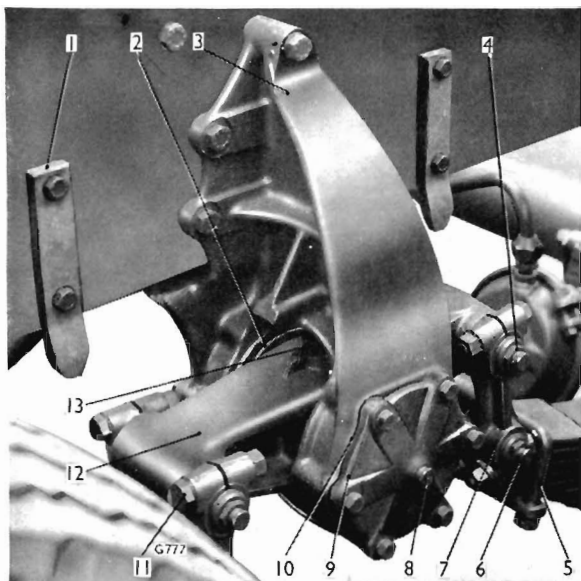


Fig. J4 Balance beam and spring shackles

**Key to Numbers:—**

1. BALANCE BEAM DOWEL
2. BALANCE BEAM
3. BALANCE BEAM BRACKET
4. BEARING OUTER COVER
5. SHIMS—BEARING OUTER COVER
6. BEARING OUTER RACE
7. BALANCE BEAM BEARING
8. SEAL
9. SEAL COLLAR
10. CENTRE PIN

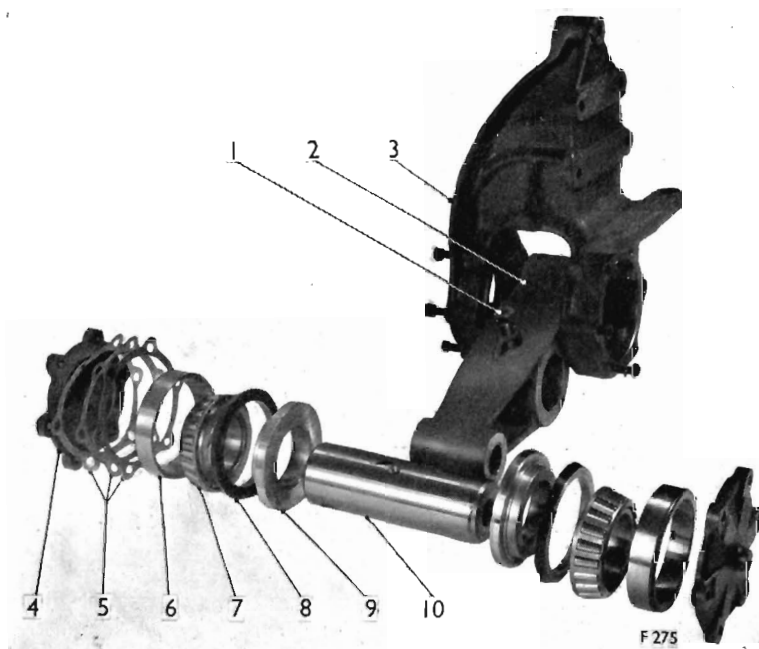


Fig. J5 Balance beam

**To Fit**

Reverse the procedure for removal noting the following points:—

Ensure that the spring locating dimple seats correctly on the axle spring carrier and that the saddle locating dowel seats correctly in the saddle and the spring.

**Note.**—On certain chassis, tapered packing is fitted between the springs and the trailing axle pads; if removed, the packing must be refitted with the thick edge towards the balance beam.

Check that the securing bolts sit squarely against the plates, or in their grooves in the saddle, fit the nuts, tightening evenly and in sequence.

Fit the spring and shackle pins as previously described.

Adjust the springs for side play as instructed under “**To Adjust**” and then ensure that the spring and shackle pin lubrication holes are clear by giving the pin a liberal charge of lubricant; the lubricant should discharge from around the pin.

Remove the chocks from under the front wheels.

**To Adjust****Spring Pins**

On certain chassis a spacing washer is fitted between the spring eye and bracket, adjustment for side play is as follows:—

Remove the lubricator or disconnect the lubrication pipe and remove the clamp bolts from the spring bracket.

Drive the pin inwards towards the centre of the

vehicle sufficiently to allow the worn spacing washer to be removed.

Fit a new spacing washer, if necessary, to give 0.040 in. (1 mm.) side play between the spring eye and bracket (*see Section 6 for thickness of washers available*). Drive the pin back into position and fit the clamp bolts ensuring that the holes are in line with the grooves in the pin.

**Shackle Pins**

Remove the lubricators or disconnect the lubrication pipes from the pins.

**On chassis fitted with plain ended shackle pins,** slacken the clamp bolts in the **outer** shackle and tap the shackle until there is 0.040 in. (1 mm.) clearance between the shackle and the spring eye and bracket. Tighten the clamp bolts and give the ends of the pins a tap in order to equalise the clearance at either side of the spring.

**On threaded adjustable shackle pins,** slacken the clamp bolts adjacent to the locknut on each shackle pin and also the outer locknut. Screw up the inner adjusting nut until just tight, then slacken until there is 0.040 in. (1 mm.) side clearance between the shackle and the spring eye and spring bracket. Tighten the clamp bolts and give the ends of the pin a tap in order to equalise the clearance at each end.

**Balance Beams****To Remove**

Jack up the **frame** to take the load off the springs and remove the two upper shackle pins from the beam as previously instructed.

Disconnect the lubrication pipe to the beam (when fitted).

Remove the bolts securing the bracket to the frame and remove the beam complete with bracket from the vehicle.

#### To Dismantle

Remove the bearing end covers and retain the shims from behind the outer end cover.

Remove the screwed dowel bolt from the balance beam.

Push out the centre pin and remove the balance beam from the bracket.

Drive out the bearings, seals and seal collars from the housings in the bracket.

Take care not to damage the lips of the oil seals.

#### To Assemble

Examine the bearings and seals for wear or damage and renew if necessary.

Lubricate the lips of the seals and fit one to each collar with the lip of each seal facing the flange.

Fit a collar and seal assembly into each bore, from the **inside** of the bracket, so that the collar is flush with the end of the bore.

Position the balance beam in the balance beam bracket and fit the centre pin. Align the dowel holes in the pin and the beam; fit the dowel bolt and secure it with locking-wire.

The bearings must now be pre-loaded in the following manner:—

Fit the bearing assemblies, **without lubricant**, to the centre pin. See Figure J5 for correct assembly of bearings.

Fit the inner bearing cover tightly to the bracket.

Fit the outer bearing cover **without shims** and, using feeler gauges, measure the gap between the cover and the bracket.

Remove the outer cover and fit shims from 0.001 in. (0.025 mm.) to 0.003 in. (0.076 mm.) **less** than the measured gap. Refit the cover.

At this stage the pre-loading of the bearings **must** be checked by measuring the torque required to move the beam on its axis.

Suspend a weight of 8½ lb. (3.8 Kg.) to 11¼ lb. (5.3 Kg.) from one shackle pin hole of the beam and the beam should just start to move; this will be equal to a torque of approximately 50 to 70 lb. in. (0.57 to 0.8 Kg. M.).

**Add** shims to **decrease** and **subtract** shims to **increase** the torque loading as required.

When the torque loading is correct, dismantle the assembly.

Fill the cavity of each seal with grease and smear the seal lip and housing with grease. Reassemble the seal assemblies and the centre pin.

Pack the bearings with grease and refit them to the centre pin (*for specification see Part S*).

Place the shims in position and refit the end covers.

#### To Fit

Examine the shackle pins for wear and renew if necessary.

Fit the balance beam bracket to the frame. Lubricate and fit the shackle pins.

If necessary adjust the spring shackles for side play as described under "To Adjust."

## Section 4

### FULLY ARTICULATED BOGIE REAR SUSPENSION

(See Figs. J6 and J7)

#### Torque Rods

##### To Remove

When more than one torque rod is to be removed, chock the leading and trailing wheels in front and behind. Support both axles and the frame on suitable packing to prevent movement.

##### Upper Rods

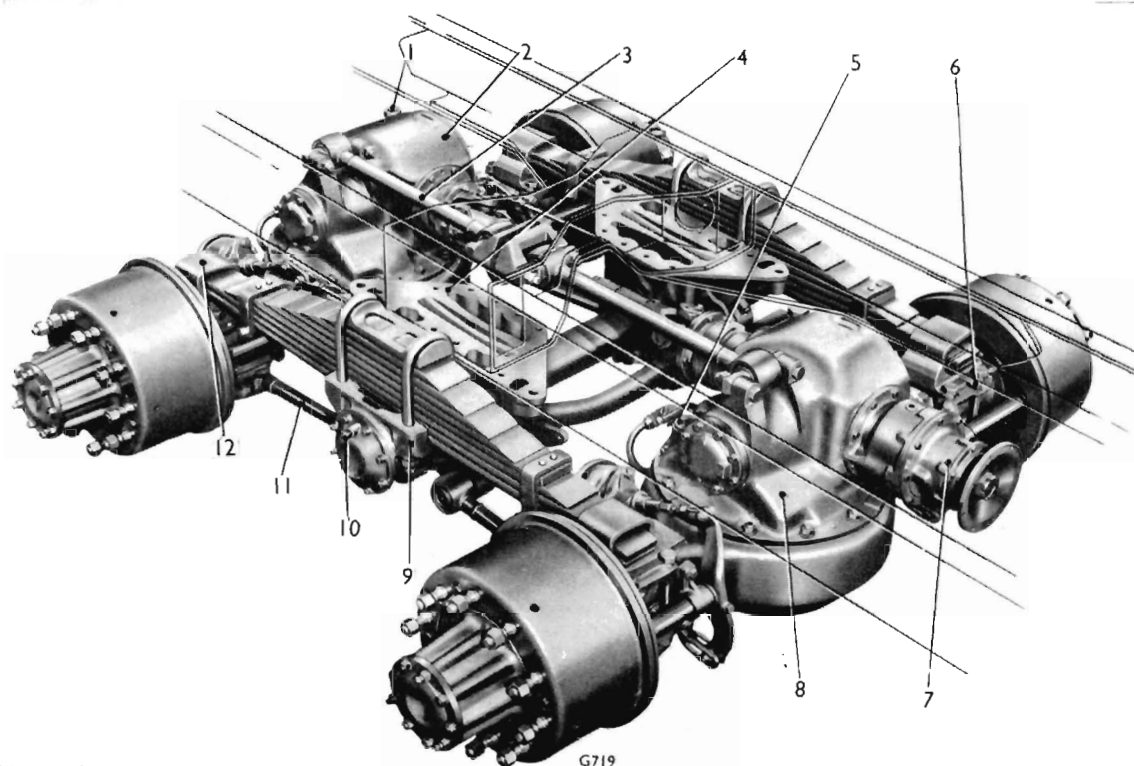
Disconnect the pivot pins from both axle casings and the frame rear crossmember; remove the rods from the vehicle and press the pivot pins out from each bush.

#### Lower Rods

Remove the nuts and washers from the torque rod pivot pins also the nuts securing the pivot bracket to the underside of the axle casing.

Use a suitable withdrawal tool to remove the tapered pin from the bogie pivot tube bracket and remove the rod from the vehicle.

Press the pin from the torque rod and detach the pivot bracket.



#### Key to Numbers:—

- |                        |                                   |                                 |
|------------------------|-----------------------------------|---------------------------------|
| 1. BREATHER            | 5. OIL FILLER—AXLE CASING         | 9. BOGIE PIVOT CRADLE           |
| 2. 2nd DRIVING AXLE    | 6. LUBRICATOR—SPRING SLIDING ENDS | 10. OIL FILLER PLUG—BOGIE PIVOT |
| 3. UPPER TORQUE ROD    | 7. THIRD DIFFERENTIAL UNIT        | 11. LOWER TORQUE ARM            |
| 4. BOGIE PIVOT BRACKET | 8. 1st DRIVING AXLE               | 12. SPRING BRACKET              |

Fig. J6 Fully articulated two spring bogie suspension

#### Bonded-rubber Bushed Bearings

**Note.**—Bonded-rubber bushed bearings are located at each end of the rod. When they become worn, the complete rod and bush assembly must be returned to any AEC Depot or Agent for renewal.

#### To Fit

Reverse the procedure given for removal noting the following:—

When new pivot pins are required, note that the tapered pins are pressed into the lower rod ends in opposed directions; they can only be pressed in as far as the register on the pin permits. Attach the axle pivot bracket to one end of the lower rod but do not secure.

On upper torque rods, the parallel pins must be pressed into the bushed bearings centrally and with their flat sides at right angles to the torque rod.

When assembling the rods to the vehicle, first fit the upper rods by bolting them to the pivot brackets each side of the frame crossmember.

Connect up the inner ends of the lower rods to the bogie pivot tube bracket, and secure the axle pivot bracket to the underside of the axle casing.

With a jack, or suitable lifting gear, raise the axle sufficiently to facilitate the fitting of the securing bolts between the upper rod and axle casing.

When the upper rods are secured, jack up each axle independently, one end at a time, so that the lower rods assume a position parallel with the frame. Tighten each torque rod when this position is obtained.

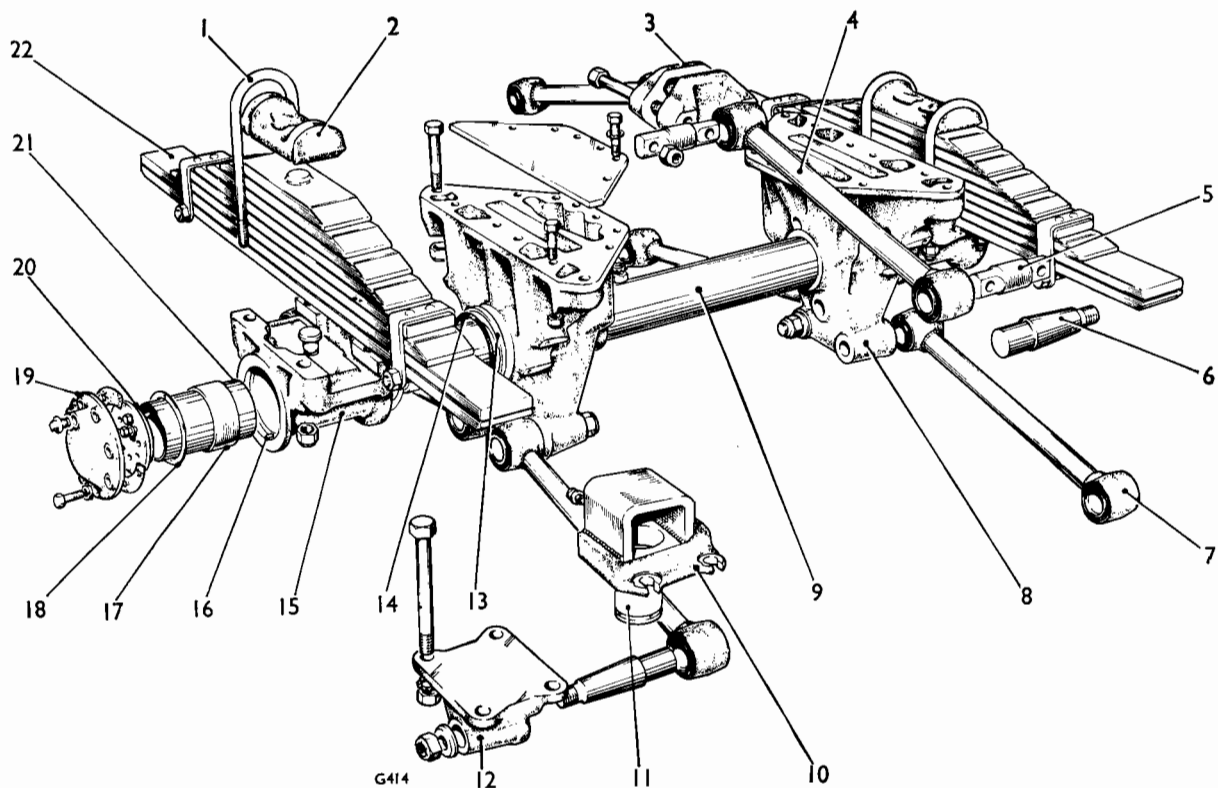
#### Springs

##### To Remove

Place chocks in front and behind the front wheels.

Jack up the frame under the bogie pivot tube bracket, **not the bogie pivot cradle**, until the spring is relieved of any frame weight.

Slacken the nuts on the underside of the torque rod pivot brackets and remove only the outer nuts and bolts at the spring ends.



#### Key to Numbers:—

1. SPRING SECURING BOLT
2. SPRING CAP
3. TORQUE ROD SECURING BRACKET
4. UPPER TORQUE ROD
5. PIVOT PIN
6. PIVOT PIN—(NOT FITTED TO BEVEL TYPE AXLE CASING)

7. LOWER TORQUE ROD
8. BOGIE PIVOT BRACKET
9. BOGIE PIVOT TUBE
10. SPRING BRACKET
11. SPRING RUBBING PAD
12. PIVOT BRACKET—AXLE CASING
13. INNER THRUST PLATE
14. RUBBER "O" RING

15. BOGIE PIVOT CRADLE
16. DOWEL PIN
17. BUSH—PIVOT CRADLE
18. THRUST WASHER
19. BOGIE PIVOT COVER
20. OUTER THRUST PLATE
21. SLEEVE—BOGIE PIVOT
22. SPRING

**Fig. J7 Fully articulated two spring bogie suspension**

With a suitable brass drift, drive the spring brackets away from each end of the spring and remove the brackets from the axle casing.

Remove the nuts from the spring securing bolts and use a pinch bar to prise the bolts clear of the carrier: detach the spring cap. On certain units, the nuts are of the self locking type.

Jack up the spring at each end as far as possible, and where necessary, use a pinch bar to force the spring away from its seating. Lift the spring clear of the cradle and lower the spring to the ground.

#### To Fit

Reverse the procedure given for removal noting the following points:—

Check the spring brackets and rubbing pads for wear. If a spring rubbing pad requires renewing ensure that the spring bracket is suitably packed and supported on a level plane before pressing out the pad. Press the new pad into position flush with the underside of the bracket.

#### Bogie Pivot Assembly

##### To Remove

Remove the road springs as detailed in the preceding paragraphs.

Remove the setscrews and bogie pivot end cover from the cradle.

**Note.**—As the bogie pivot tube is filled with oil, it is advisable to remove the cover from each pivot cradle and drain the oil into a suitable container.

Remove the locking wire and setscrews from the outer thrust plate and detach the plate and thrust washer.

Slide the pivot cradle from the sleeve and lower the cradle to the ground. Remove the rubber "O" ring and inner thrust washer. Press out the bushes from the cradle.

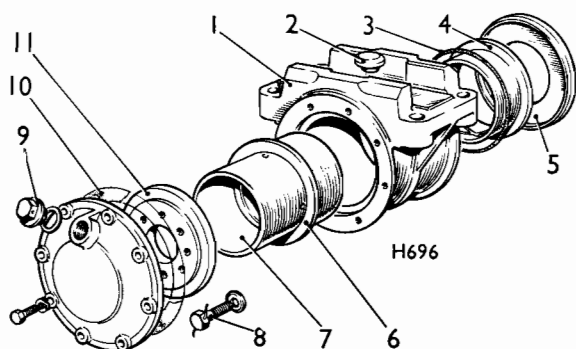
Remove the sleeve and inner thrust plate from the bogie pivot tube.

If the pivot cradle **flanged** type bushes (*see Fig. J8*) require renewing, use a suitable soft drift to drive the bushes out. **Plain** type bushes can be pressed out.

### To Fit

Reverse the procedure for removal noting the following:—

Examine the pivot cradle bushes and where necessary renew.



#### Key to Numbers:—

1. BOGIE PIVOT CRADLE
2. DOWEL—SPRING SEAT
3. "O" RING
4. FLANGED BUSH—INNER
5. THRUST PLATE—INNER
6. FLANGED BUSH—OUTER
7. SLEEVE—BOGIE PIVOT TUBE
8. SETBOLT AND WASHER—OUTER
9. THRUST PLATE TO BOGIE PIVOT TUBE
9. FILLER PLUG AND WASHER—COVER
10. JOINT—COVER
11. THRUST PLATE—OUTER

**Fig. J8 Bogie pivot cradle assembly with flanged bushes (alternative)**

Assemble the inner thrust plate on the pivot tube with its flat side against the bogie pivot bracket. Smear the inside of the sleeve with grease to facilitate entry, and drive the sleeve on to the tube with a lead hammer.

Inspect the rubber "O" ring for wear and renew if necessary. Fit the "O" ring into its recess and pack with grease before fitting the pivot cradle.

If the pivot cradle **flanged** type bushes are being renewed, the bushes should be pressed into each end of the cradle so that the flange locates against the cradle.

**Plain** type bushes should be pressed into each end of the pivot cradle just below the surface of the inner machined face.

Check the dowel pins on both sides of the pivot cradle for damage and renew if necessary.

Fit **new** thrust washers on the pins, ensuring that the treated (black) surface of the washer bears against the thrust plate face of the pivot cradle. These mating surfaces must be smooth and clean, otherwise the treated (black) surface of the washer will be impaired and its lubricating qualities destroyed.

Grease the bogie pivot tube and then assemble the cradle.

**On both types**, fit the cradle to the pivot tube, ensuring that the "O" ring is not damaged and that it is correctly seated in its recess.

Assemble the outer thrust plate, with its flat side against the bogie pivot tube ensuring that the thrust washers are properly located. Fit the setscrews and tighten them in logical sequence to a torque loading of 65 lb. ft. (8.9 kg. m.); secure the setscrews, in pairs, with locking wire.

Fit a new paper joint to the bogie pivot cover with non-hardening jointing compound and fit the cover to the pivot cradle with the filler plug **at the top**.

## Section 5

## ENGINE MOUNTINGS

(See Figs. J9 and J10)

### To Remove

#### Front Mountings

Apply the parking brake.

Remove the nuts from the bolts securing the engine mountings to the engine and the mounting brackets.

Using a suitable hardwood block placed under the front of the engine sump and a heavy duty hydraulic jack, support the weight of the engine.

**Note:—It is extremely important that the weight of the engine is supported only;** the unit should **not** be jacked up unnecessarily, otherwise damage may be caused to the radiator, fan blades, hoses etc.

Remove the bolts and withdraw the bonded rubber sandwich unit from its mounting.

#### Rear Mountings

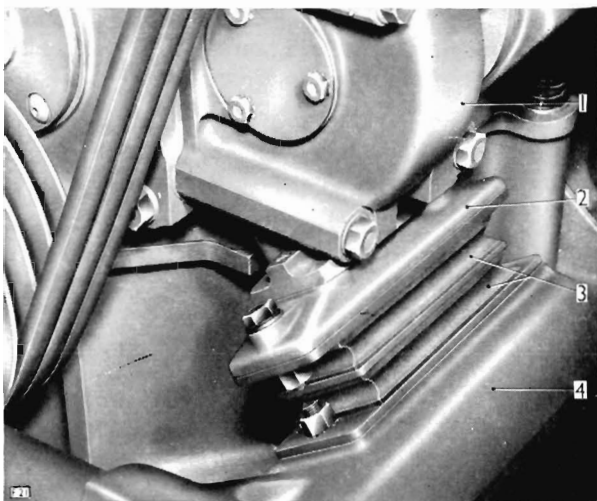
Apply the parking brake.

Tilt the cab (*see Part A*).

On certain chassis there is insufficient clearance between the flywheel housing and the cab rear support crossmember to permit the engine to be raised the required amount for the removal of the mountings. The engine should, therefore, be removed as instructed in Part A and the bonded rubber mounting removed from its bracket.

When there is sufficient clearance, proceed as follows:—

Disconnect the change speed shaft at the rear muff coupling.



#### Key to Numbers:—

1. COMBINED DRIVE HOUSING  
AND  
ENGINE SUPPORT BRACKET

2. DISTANCE PIECE

3. BONDED-RUBBER BUFFERS

4. FRAME BRACKET

Fig. J9 Typical engine front left-hand mounting

If necessary, drain the air system (*see Part A*), and disconnect any air supply pipes liable to cause obstruction.

Disconnect the propeller shaft universal joint from the gearbox output flange and tie the shaft to a convenient point on the chassis to prevent damage.

Using a suitable hardwood block placed under the gearbox casing and a heavy duty hydraulic jack or, alternatively, remove the trap from over the gearbox and with a sling around the boss of the gearbox output flange attached to a suitable lifting tackle, support the weight of the engine and gearbox.

Remove the mounting bolt from the rear mountings, retaining the rebound plate and packing washer.

Remove the bolts securing the bonded rubber mounting to the engine mounting bracket.

**On chassis having a gearbox fitted with auxiliary gears**, disconnect the suspension units located at the rear of the auxiliary gear casing.

Raise the gearbox sufficiently to permit the removal of the bonded rubber mountings from the brackets; retain the locating dowel.

**Note:**—On certain chassis it may be necessary to remove the bolts securing the engine mounting bracket to the chassis and manoeuvre the bracket in order to facilitate the removal of the mounting.

#### To Fit

##### Front Mountings

Examine the bonded rubber sandwich units for wear and renew if necessary; reverse the procedure given for removal.

##### Rear Mountings

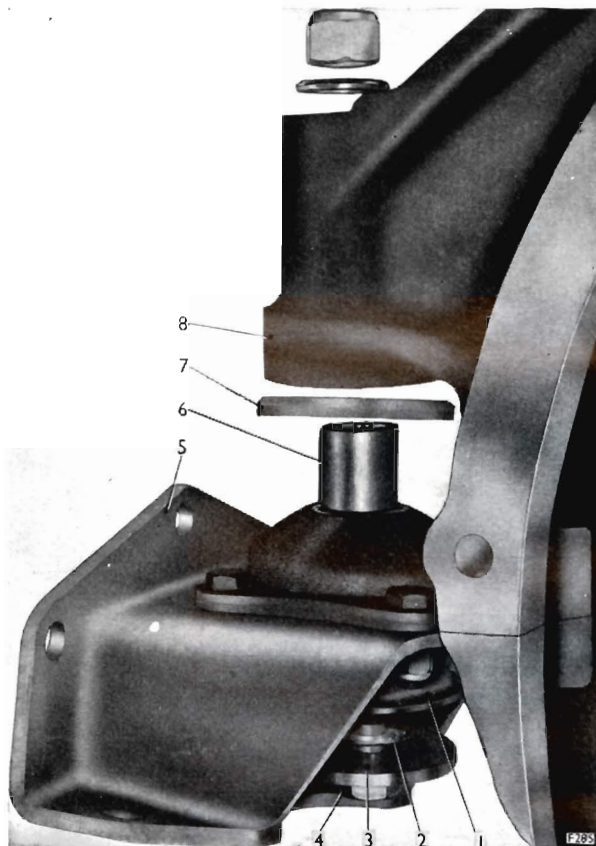
Reverse the procedure given for removal noting the following points.

Examine the bonded rubber unit for wear and renew, if necessary.

Ensure that the locating dowel is fitted to the mounting.

**Note:**—Should it be found necessary to remove the mounting brackets from the engine, ensure that, if self-locking type nuts are fitted, they are tightened to a torque load of 100 lb. ft. (13.8 kg. m.) when refitting the bracket.

If disconnected, ensure that the change speed shaft is correctly coupled up in relation to the change-speed lever, and that the selector levers obtain all the gears in the box.



#### Key to Numbers:—

1. RUBBER-BONDED UNIT

2. PACKING WASHER

3. REBOUND PLATE

4. MOUNTING BOLT

5. ENGINE MOUNTING  
BRACKET

6. LOCATING DOWEL

7. LOCATING WASHER (WHEN  
FITTED)

8. ENGINE BELL HOUSING

Fig. J10 Typical engine rear mounting



NOTES

**NOTES**

## NOTES

# PART K69

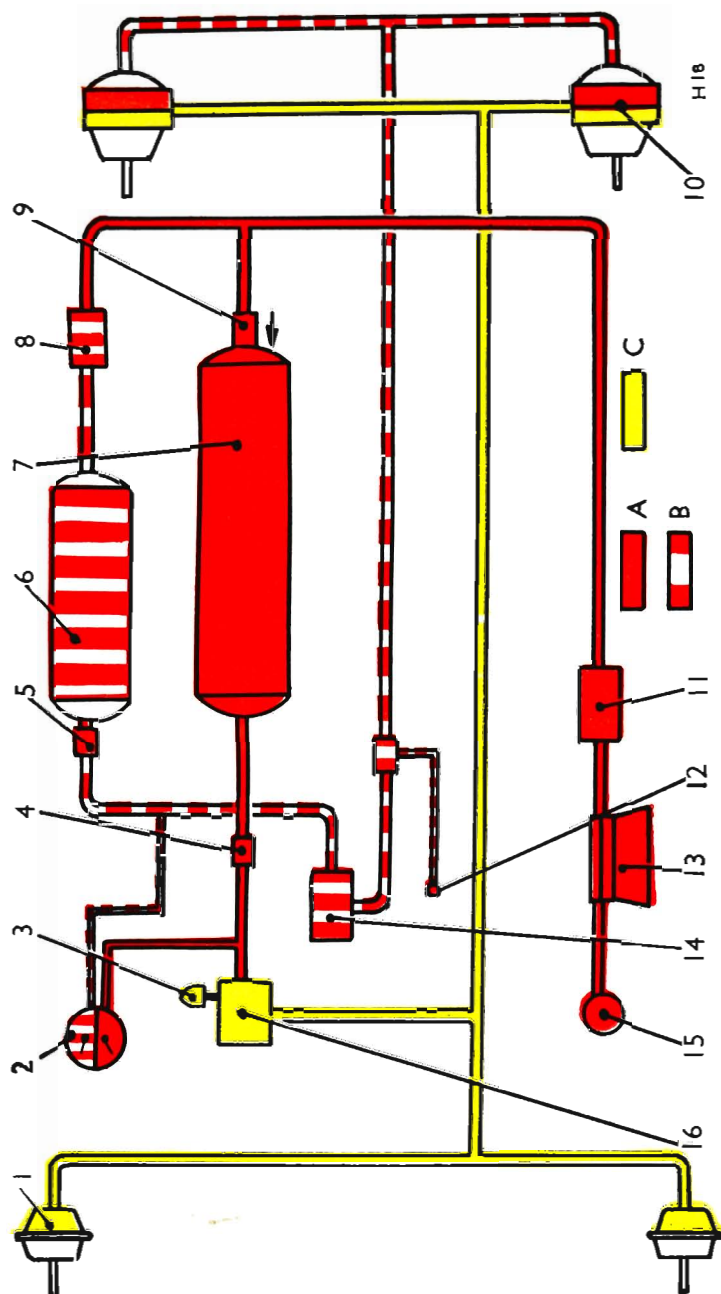
## BRAKES

(Air Pressure Operated)

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To Dismantle and Assemble			
To Test and Adjust			

**K69**



**Key to Letters and Numbers:—**

- |  |   |   |
|--|---|---|
| <b>A.</b> AIR SUPPLY TO RESERVOIRS                   | <b>7.</b> AIR RESERVOIR—FOOT BRAKE AIR CHAMBERS           | <b>12.</b> STOP LIGHT SWITCH                        |
| <b>B.</b> PARKING BRAKE OPERATION                    | <b>8.</b> REGULATING VALVE                                | <b>13.</b> AIR COMPRESSOR                           |
| <b>C.</b> FOOT BRAKE OPERATION: FRONT AND REAR AXLES | <b>9.</b> NON-RETURN VALVE                                | <b>14.</b> CONTROL VALVE—AIR ASSISTED PARKING BRAKE |
|  | <b>10.</b> MULTIPLE DIAPHRAGM BRAKE AIR CHAMBER—REAR AXLE | <b>15.</b> AIR CLEANER                              |
|  | <b>11.</b> UNLOADER VALVE                                 | <b>16.</b> BRAKE VALVE                              |

Diagrammatic layout of single line air pressure system for load carrier chassis

## Section 1

## FOOT AND PARKING BRAKES

## To Adjust

**Foot Brake—Girling type**

Jack up the axle or each wheel in turn, releasing the hand brake to the fully "off" position and chocking the front wheels in front and behind when adjusting the rear brakes.

Turn the square ended adjusting stem in a **clockwise** direction, until the brake shoe linings contact the drum, then unscrew the stem until the road wheel rotates freely with the brake linings just clear of the brake drum.

If replacement shoes have been fitted or the brake shoes have been relined, the following procedure should be adopted for the brake adjustment.

Fit the brake drum with the brake adjuster stem turned fully **anti-clockwise**, then adjust the brakes as described in the previous paragraphs.

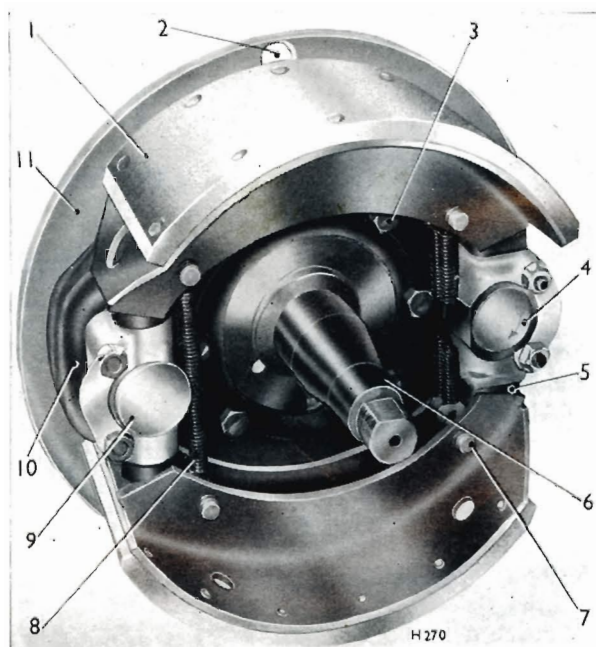
Centralise the shoes by depressing the brake pedal several times, after which the shoes can probably be expanded further by turning the adjuster stem.

Re-adjust the brakes as previously described.

**Parking Brake**

**Note.**—The parking brake rods are set to a predetermined length and should not in any circumstances be altered. If new brake rods are being fitted, setting instructions must be obtained from any AEC Service Depot or Agent.

Provided the lengths of the brake rods have not been altered from their initial setting, adjustment of the foot brake as described in the previous paragraphs will automatically adjust the parking brake.

**Key to Numbers:—**

- |                                       |  |
|---------------------------------------|--|
| 1. BRAKE SHOE LINING                  | 6. FRONT AXLE SWIVEL                     |
| 2. BRAKE SHOE INSPECTION APERTURE     | 7. ANCHOR PIN—BRAKE SHOE PULL OFF SPRING |
| 3. BRAKE SHOE ASSEMBLY SECURING BOLTS | 8. BRAKE SHOE PULL-OFF SPRING            |
| 4. EXPANDER UNIT                      | 9. ADJUSTER UNIT                         |
| 5. TAPPET                             | 10. TORQUE PLATE                         |
|                                       | 11. DUST SHIELD                          |

**Fig. K1 R.H. Girling brake shoe assembly—front axle**

## Section 2

## UNEVEN BRAKING

Although the torque delivered to all the brake camshafts may be equal, grease, oil or any foreign substance on the brake linings so changes the coefficient of friction that the brakes become uneven.

This inequality must be remedied and the cause of oil or grease leakage to the linings must be located and rectified. Clean the brake drums before fitting.

Examine the surplus grease escape holes in the front hubs for signs of grease leakage and, if necessary, renew the seals (*see Part G*); on the rear axle, examine the seals and renew if necessary (*see Part H*).

Should the linings be thoroughly saturated with any form of lubricant, the only satisfactory remedy is to reline all the shoes on the same axle (*see Section 3*).

## Section 3

## BRAKE SHOES

(Girling type)

(*See Figs. K2 and K3*)

## To Remove

Jack up the axle, remove the road wheel and brake drum (*see Parts G and H*).

Take the weight of the assembly by supporting the lower brake shoe, taking care not to damage the lining.

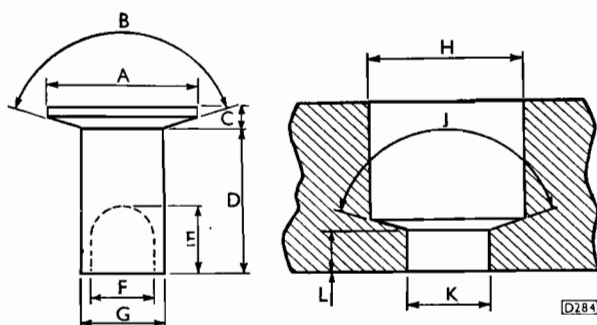
Insert the tool listed in the Maintenance Equipment

into the aperture in the upper shoe and release the tension on the pull-off spring pin by levering on the spring stirrup; withdraw the pin.

Retain the lower expander and adjuster tappets in position by fitting the keepers, listed in the Maintenance Equipment, then repeat the above procedure on the lower shoe.

Lift the shoes clear of the torque plate.

**Note.**—It is necessary to detach the expander and adjuster tappets from the bottom of their respective housings; detach also the expander strut (see Sections 5 and 6).



#### Key to Letters:—

- A. = 15/32 in. dia. (12 mm.)
- B. = 150°
- C. = 1/16 in. (1.6 mm.)
- D. =  $\begin{cases} 33/64 \text{ in. (13 mm.) FRONT} \\ 33/64 \text{ in. (13 mm.) REAR} \\ 13/32 \text{ in. (10 mm.)} \end{cases}$
- E. = 0.2 in. (5 mm.)
- F. = 3/16 in. dia. (4.75 mm.)
- G. = 1/4 in. dia. (6.3 mm.)
- H. = 1/2 in. dia. (13 mm.)
- J. = 145°
- K. =  $\begin{cases} 0.272 \text{ in. (7 mm.)} \\ \text{LETTER "I" DRILL} \end{cases}$
- L. = 3/32 in. (2.4 mm.)

Fig. K2 Dimensions of Girling brake shoe lining rivets and rivet holes

#### To Recondition

**Note.**—To ensure maximum braking efficiency, the same make and grade of linings must be used for all shoes on any one axle.

The brake linings should be renewed when they have worn to a thickness slightly above the top of the rivet head.

Replacement lined shoes are available from any AEC Service Depot or Agent, but shoes may be relined as follows:—

Remove the brake shoes and strip off the old linings from the shoes.

Using the shoe as a jig, position the new lining on it, drill and counterbore the holes for the rivets and

rivet on the lining with brass rivets (see Fig. K2). Make sure that the rivet heads are well down beneath the surface of the lining and that a good “snap” head is formed.

After riveting, plug the recesses with cork plugs and remove all burrs with a file.

If facilities are not available for grinding the linings, so that their outside diameter suits the inside diameter of the brake drum, the vehicle should be given an initial run to allow the brake shoe linings to “bed” themselves in the brake drum.

#### To Fit

Thoroughly clean all parts and grease all moving parts, ensuring not to get grease on the brake shoe linings.

Turn the adjuster stem **anti-clockwise** to the fully “off” position.

Pair the shoes so that they are positioned as shown in Figure K3, and fit new pull-off springs to each pair of shoes.

Place the pair of shoes with the springs attached against the torque plate, with one end of one shoe on the inclined abutment astride the expander tappet and the other end on the adjuster tappet. Then prise the other shoe into position on to the other abutment and adjuster tappet.

When the front or rear axle shoes have been fitted, tap the shoes to ensure that they slide freely.

Fit the hubs (see Parts G or H).

Ensure that the brake drums are clean and free from grease, then fit (see Parts G or H).

Adjust the brakes as described in Section 1.

#### DIRECTION OF FORWARD ROTATION OF BRAKE DRUM

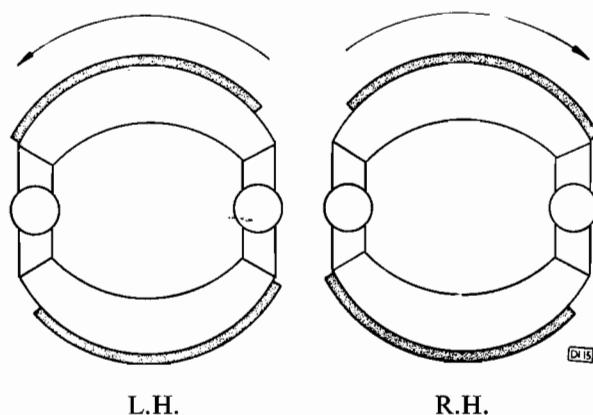


Fig. K3 Fitting of brake shoes  
Note relationship of brake linings to rotation of drum

## Section 4

# BRAKE DRUMS (Used with Girling brakes)

**To Remove**

Remove the brake drum as instructed in Part G or H.

**To Recondition**

If necessary, brake drums can be skimmed to obtain a smooth, polished surface, care being taken to remove as little metal as possible.

A maximum of  $\frac{1}{4}$  in. (6.4 mm.) on the diameter may be removed, i.e., the inside diameter of the brake drum should not, at any time, exceed  $15\frac{3}{4}$  in. (400 mm.).

To compensate for the metal removed, special washers are available for packing out the adjuster tappets and a brake shoe pull-off spring stirrup to allow for the increased tension on the spring, the packing washers and stirrup should be fitted as shown in Figure K4.

These packing washers and stirrup can also be used to allow the maximum wear on the brake shoe linings before relining becomes necessary.

**Key to Numbers:—**

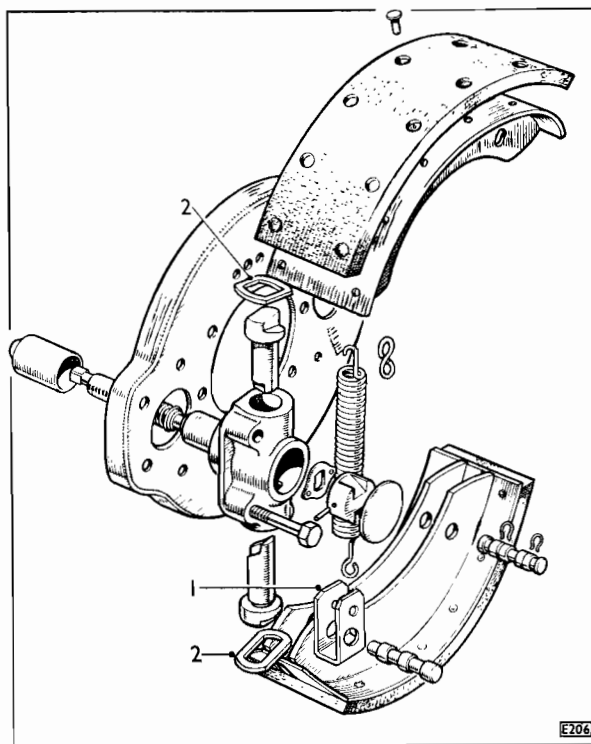
1. PULL-OFF SPRING STIRRUP      2. PACKING WASHER

Fig. K4 Method of fitting brake adjuster tappet packing washers and brake shoe pull-off spring stirrup to Girling type brakes

**Note.**—If new brake linings and drums are fitted it is most important that the packing washers and stirrup are removed.

**To Fit**

Fit the brake drum as instructed in Part G or H.



# Section 5      BRAKE OPERATING SHAFT AND EXPANDER UNIT

(Girling early type)

(See Fig. K5)

(For late type unit, refer to section 5A on Page K41).

**To Dismantle**

Remove the brake shoes (see Section 3).

Detach the upper expander tappet and strut from the housing; the lower tappet and strut will be detached during the removal of the brake shoes.

Remove the fork-end pin from the brake operating lever and remove the clamping bolt and lever. Remove the felt washer from the rear axle brake operating shaft.

On the rear axle expander unit, disconnect the lubrication pipe (if fitted) from the operating shaft bearing bracket. Remove the nuts securing the bearing bracket to the axle casing and slide the bracket, cover tube and bush from the end of the shaft.

Remove the lubricator from the front axle expander housing.

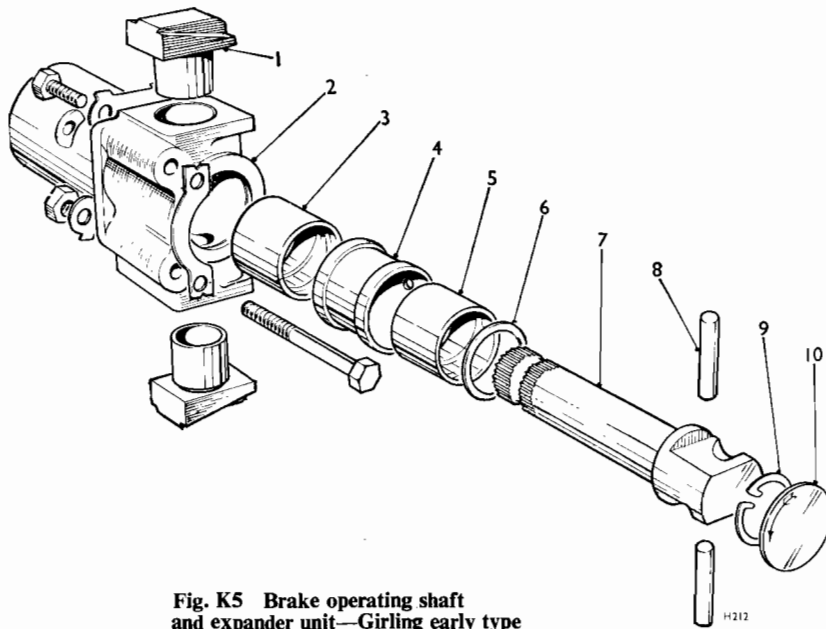
Remove the expander housing from the torque plate.

Tap the end cap from the housing and remove the circlip retaining the operating shaft. Remove the shaft and thrust washer.

Remove the two bushes and the distance piece from the front axle expander housing. Remove the bush from the rear axle expander housing.

**To Assemble**

Thoroughly clean and examine all parts for signs wear and renew where necessary.



**Fig. K5 Brake operating shaft and expander unit—Girling early type**

**Key to Numbers:—**

1. TAPPET
2. EXPANDER HOUSING
3. BUSH
4. DISTANCE PIECE
5. BUSH
6. THRUST WASHER
7. BRAKE OPERATING SHAFT
8. STRUT
9. CIRCLIP
10. END CAP

Reverse the sequence for dismantling noting the following:—

When fitting new bushes into the front axle expander unit, press them in so that they are flush with each end of the housing. The bush for the rear expander unit, should be pressed in flush with the strut end of the housing.

Fit the thrust washer with its chamfered side towards the strut end of the shaft and smear the assembly with grease before inserting into the expander housing.

Ensure that the felt washer on the rear axle brake operating shaft is fitted before assembling the brake lever.

## Section 6

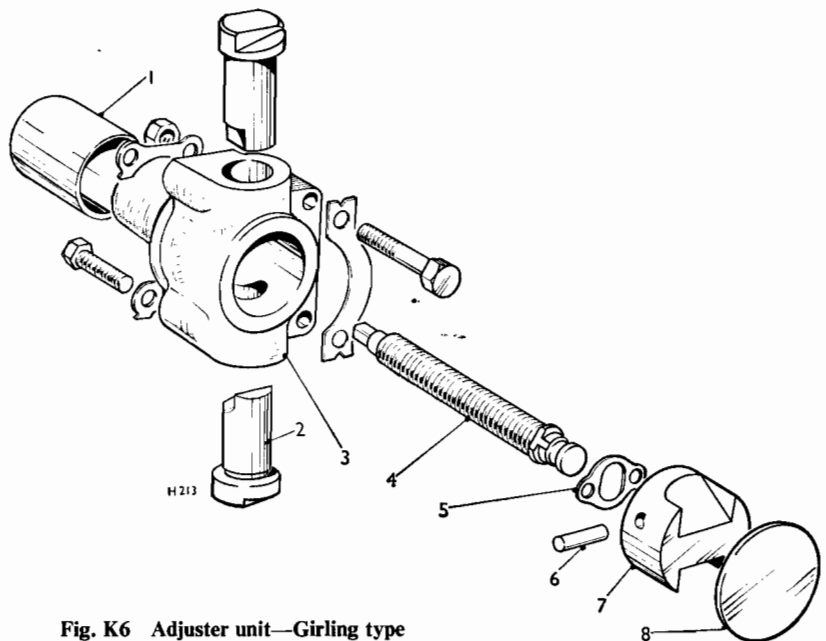
### BRAKE ADJUSTER UNIT

(Girling type)

(See Fig. K6)

**Key to Numbers:—**

1. BUSH
2. TAPPET
3. ADJUSTER HOUSING
4. ADJUSTER STEM
5. CLICKER SPRING
6. WEDGE RETAINING PIN
7. WEDGE
8. DUST CAP



**Fig. K6 Adjuster unit—Girling type**

### To Dismantle

Remove the brake shoes (*see Section 3*).

Remove the adjuster housing securing bolts and setscrews from the torque plate and lift off the housing.

Remove the upper tappet from the housing, noting its position to ensure that it is fitted the same way on assembly; the lower tappet will be detached during

the removal of the brake shoes.

Prise off the dust cap from the housing, screw the adjuster stem inwards (clockwise), then shake out the pins attaching the wedge to the stem and remove the wedge and clicker spring.

### To Assemble

Thoroughly clean all parts, smear with clean grease and assemble in the reverse order to dismantling.

## Section 7

## BRAKE AIR CHAMBERS

(*See Figs. K7, K8, and K9*)

### To Remove

Drain the air pressure system (*see Part A*).

Release the brake operating rod by removing the fork-end pin at the operating end of the rod.

Disconnect the air supply pipe(s) from the chamber and plug the ends of the pipe(s) to prevent the ingress of foreign matter.

Remove the air chamber from its bracket.

### Single Diaphragm Type (*See Fig. K7*)

#### To Dismantle

Slacken the fork end locknut and unscrew the fork end from the brake rod.

Mark both halves of the body in relation to the clamping ring to ensure the same location on assembly. Relieve the tension of the pressure return spring on the diaphragm and clamping ring, by extending the push rod and clamping it in a vice on the plain portion of the rod, or fit a suitable sleeve over the push rod and secure by a nut as shown in Figure K7.

Remove the securing bolts and taking care not to distort the clamping ring, slightly spread the ring and push it off the halves of the body.

Release the pressure half of the body and diaphragm. Remove the unit from the vice, or remove the sleeve, withdraw the push rod assembly, pressure return spring, seal spring and seal assembly.

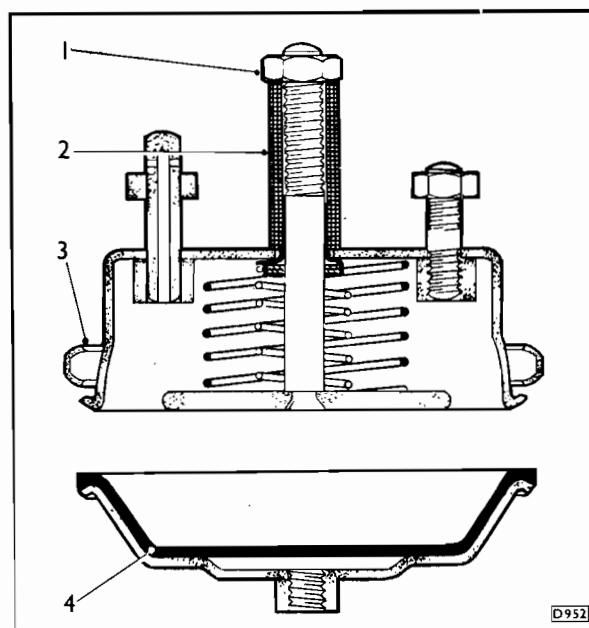
#### To Assemble

Thoroughly clean and examine all parts for signs of wear or distortion, taking special note of the diaphragm and seal assembly; renew parts where necessary (*see Part A*).

**Note.**—When it becomes necessary to renew a diaphragm (*see Part A*) or spring, ensure that a corresponding renewal is made to each chamber at the same time.

Ensure that the air vent holes in the non-pressure plate are clean and free from obstruction.

Fit the seal spring, seal assembly and diaphragm



#### Key to Numbers:—

- |                 |                  |
|-----------------|------------------|
| 1. NUT—PUSH ROD | 3. CLAMPING RING |
| 2. SLEEVE       | 4. DIAPHRAGM     |

**Fig. K7** Method of securing push rod and fitting clamping ring in position on the non-pressure plate—single diaphragm brake chamber

return spring over the push rod assembly and insert it into the non-pressure plate.

Place the clamping ring over the body flange, align the marks on the body and clamping ring, depress the push rod assembly against the spring pressure until the piston is below the level of the clamping ring, then secure in a vice or fit the sleeve previously used in the dismantling and secure with the push rod nut.

Lay the diaphragm in the pressure half of the body, then fit the body into the clamping ring so that the aligning mark made before dismantling is in line with the mark on the clamping ring.

Draw the open ends of the clamping ring together, insert the securing bolts and do not overtighten (*see "To Test"*).

Remove the Sleeve.

#### Multiple Diaphragm Type (*see Figs. K8 and K9*)

##### To Dismantle

The method of dismantling and assembling the multiple type brake chambers is basically the same as described in **Single Diaphragm Type** but with the following differences.

Remove the securing bolts and clamp rings, detach the air inlet ring, rubber diaphragms and the pressure plate; the vent ring on the **Clayton Dewandre** unit (*see Fig. K9*) will be detached with the diaphragms. On **Westinghouse** units (*see Fig. K8*) remove, if necessary, the seal assembly from the centre block of the diaphragm.

##### To Assemble

Thoroughly clean and examine all parts for signs of wear or distortion, taking special note of the diaphragm and seal assembly; renew parts where necessary (*see Part A*).

**Note.**—When it becomes necessary to renew a

diaphragm (*see Part A*) or spring, ensure that a corresponding renewal is made to each chamber at the same time.

Ensure that the air vent holes in the non-pressure plate, or the vent ring, are clean and free from obstruction.

Fit the seal spring, seal assembly and diaphragm return spring over the push rod assembly and insert it into the non-pressure plate.

##### Clayton Dewandre (*see Fig. K9*)

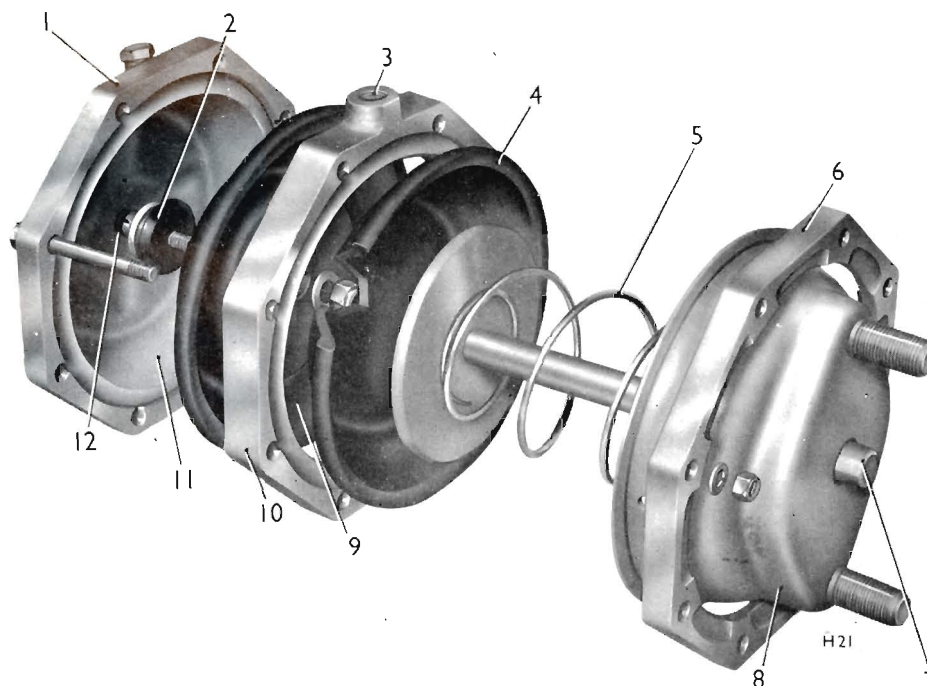
Fit the plain diaphragm first, followed by the air inlet ring and diaphragm with the centre block. Fit the vent ring, remaining diaphragm and the pressure plate.

Fit the seal spring, seal assembly and diaphragm return spring over the push rod assembly and insert it into the non-pressure plate.

##### Westinghouse (*see Fig. K8*)

When renewing the lip seal, ensure that the seal is centrally located on the diaphragm before tightening the locknut.

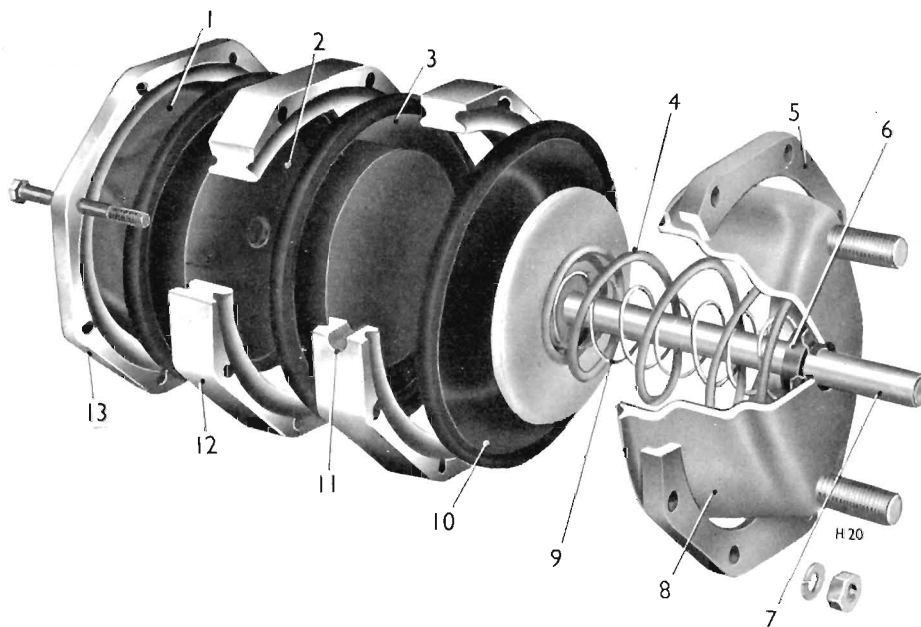
Fit the diaphragm return spring over the push rod and insert it into the non-pressure plate.



#### Key to Numbers:—

- |                                      |                           |                                       |
|--------------------------------------|---------------------------|---------------------------------------|
| 1. CLAMPING RING                     | 5. PUSH ROD RETURN SPRING | 9. DIAPHRAGM WITH CENTRE BLOCK        |
| 2. LIP SEAL                          | 6. CLAMPING RING          | 10. AIR INLET RING                    |
| 3. AIR INLET PORT—FOOT BRAKE CIRCUIT | 7. PUSH ROD               | 11. PRESSURE PLATE                    |
| 4. PLAIN DIAPHRAGM                   | 8. NON-PRESSURE PLATE     | 12. AIR INLET PORT—HAND BRAKE CIRCUIT |

Fig. K8 Double diaphragm brake chamber



**Key to Numbers:—**

- |  |                                   |                                       |
|--|-----------------------------------|---------------------------------------|
| 1. PRESSURE PLATE WITH AIR INLET FROM HAND BRAKE CIRCUIT | 5. CLAMPING RING                  | 10. PLAIN DIAPHRAGM                   |
| 2. } DIAPHRAGM WITH CENTRE BLOCK                         | 6. SEAL ASSEMBLY                  | 11. AIR INLET RING—FOOT BRAKE CIRCUIT |
| 3. }   | 7. PUSH ROD                       | 12. VENT RING                         |
| 4. PUSH ROD RETURN SPRING                                | 8. NON-PRESSURE PLATE             | 13. CLAMPING RING                     |
|  | 9. RETAINING SPRING—SEAL ASSEMBLY |                                       |

**Fig. K9 Triple diaphragm brake chamber**

Fit the plain diaphragm first, followed by the air inlet ring and diaphragm with the centre block. Fit the pressure plate.

**On both types,** fit the clamping bolts with their threaded ends towards the non-pressure plate and tighten the nuts in logical sequence.

**To Fit**

Reverse the procedure for removal noting the following:—

Grease the end of the push-rod on the **rear** brake chambers and check that the end of the push rod does not bind with the brake lever when the brakes are fully applied. If necessary re-position the fork end.

**To Test**

Should facilities be available, the unit may be tested

on a suitable test rig, if not, test on the chassis as follows:—

Charge the system with air, and with the brakes fully applied, the chamber round the pressure side of the clamping ring(s) should be covered with a solution of soapy water, at the same time watching for bubbles which will denote leakage.

If leakage is detected, check the tightness of the clamping ring securing bolts; **do not overtighten** as this will tend to distort the diaphragm(s).

Check also for leakage through the diaphragm(s), by applying soapy water to the air vent holes on the non-pressure side of the chamber, and, if leakage is found, renew the diaphragm(s).

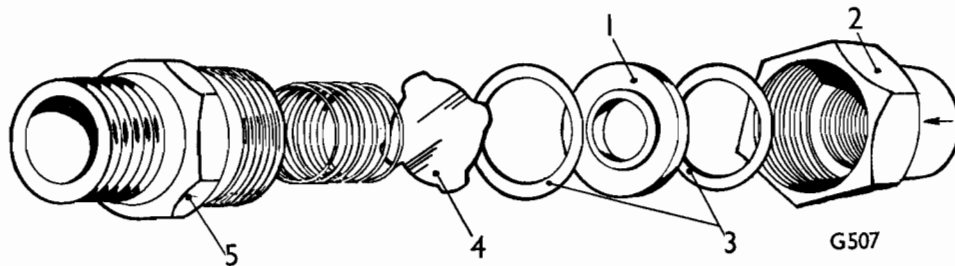
Check that the push rod operates promptly on application or release of the brakes.

## Section 8 AIR RESERVOIRS, NON-RETURN AND CHANGE OVER VALVES

(See Figs. K10, K11 and K12)

**Note.**—Load carrier chassis with a single line braking system have a non-return valve fitted in the input end of the main braking reservoir. When dual

line braking is fitted, the system has two separate air storage reservoirs with non-return valves fitted at their input ends to prevent one reservoir from draining the



**Key to Numbers:—**

1. VALVE SEAT  
2. VALVE CAP

3. COPPER SEALING WASHERS  
4. DISC VALVE

5. BODY

**Fig. K10 Non-bias type non-return valve—Westinghouse**

other. Similarly, on tractor chassis with a semi-trailer, the air supply in both the main brake and auxiliary brake reservoirs is protected by two non-return valves. On certain chassis, bias type non-return valves are fitted.

**To Remove**

**Reservoirs**

Release the air from the system (*see Part A*).

Disconnect the air pipes from the reservoirs and plug the entries to the pipes and unions on the reservoir(s) to prevent the ingress of foreign matter.

Support the reservoirs, remove the metal straps and lower the reservoirs; retain the packing strips and spacing member (when fitted).

**Non-return Valves (Non-bias and Bias types)**

Disconnect the valves from the pipe lines and reservoirs.

If the valves require cleaning, unscrew the cap nut from each valve and remove the valve seating and copper washers; on **Clayton Dewandre type valves**, detach the rubber valve, spring and valve stop from the body whilst on **Westinghouse type valves**, detach the disc valve and spring from the body.

**Change Over Valves (*see Fig. K12*).**

Unscrew the setscrews and remove the cap and rubber "O" ring from the body; detach the shuttle valve and guide from the cap.

It is not necessary to remove the plastic cover and rubber diaphragm as they serve as a blanking piece.

**To Fit**

**Reservoirs**

Reverse the procedure for removal, fitting new packing strips and drain plug washers, if required.

After fitting the reservoirs, charge the system up to maximum unloader valve pressure (*see Section 18*) and observe that the pressure loss over a period of 5 minutes does not exceed 15 lb. per sq. in. (1.05 Kg. per sq. cm) and during a further period of 25 minutes the pressure loss does not exceed 20 lb. per sq. in. (1.4 Kg. per sq. cm.).

**Non-return Valves (Non-bias and Bias types)**

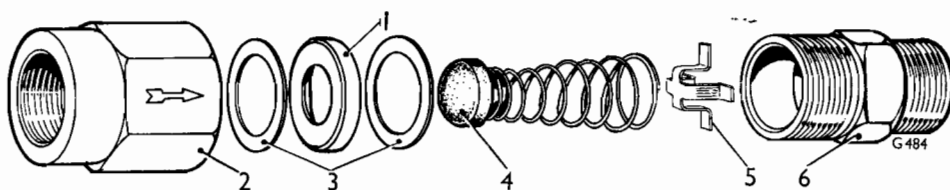
Reverse the procedure for removal; if the valves have been dismantled, attend to the following:—

Wash all parts in clean paraffin.

Examine the valve seating for wear and, if necessary, renew. Inspect the valve spring and renew if distorted or corroded.

On **Westinghouse type valves**, ensure that the raised portion of the valve seating is fitted against the valve disc with copper washers either side of the seating.

On **Clayton Dewandre type valves**, ensure that the chamfered portion of the valve seating is fitted against the rubber valve with copper washers either side of



**Key to Numbers:—**

1. VALVE SEATING  
2. VALVE CAP

3. COPPER SEALING WASHERS  
4. RUBBER VALVE

5. VALVE STOP  
6. VALVE BODY

**Fig. K11 Non-bias type non-return valve—Clayton Dewandre**

the seating. Check the rubber valve for deterioration, and note that the valve stop is fitted **feet first** into the valve body.

On all valves, ensure when fitting, that they are correctly positioned in relation to the direction of flow, as indicated by the arrow on the cap nut of the valve.

#### Change Over Valves (see Fig. K12)

Reverse the procedure for removal; if the valves have been dismantled, attend to the following:—

Wash all parts in clean paraffin.

Examine the "O" ring and shuttle valve for deterioration of the rubber and if necessary renew. The rubber bead at each end of the valve must be free from wear. Check also the shuttle sleeve and guide for excessive scoring.

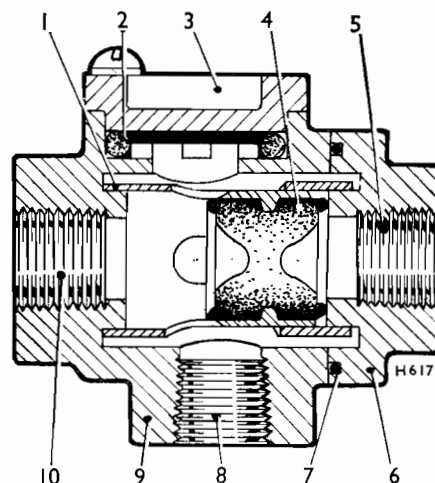
Lightly smear the shuttle valve sleeve and guide with a barium based grease prior to assembly.

If the plastic cover and rubber diaphragm have been removed, fit the diaphragm into the valve body with the plain side uppermost. Finally, tighten all screws securely.

#### To Test

After installation, all valves should be tested for air leakage as follows:—

Run the engine until normal operating pressure is attained in the air reservoirs, then stop the engine.



#### Key to Numbers:—

- |                        |                    |
|------------------------|--------------------|
| 1. SHUTTLE VALVE GUIDE | 6. CAP             |
| 2. RUBBER DIAPHRAGM    | 7. RUBBER "O" RING |
| 3. COVER               | 8. OUTLET PORT     |
| 4. SHUTTLE VALVE       | 9. BODY            |
| 5. AIR INLET PORT      | 10. AIR INLET PORT |

Fig. K12 Change over valve

## Section 9

### UNLOADER VALVE

(See Figs. K13, K14 and K15)

#### Method of Operation

The purpose of the unloader valve is to relieve the air compressor of the pumping load when the reservoir is charged to operating pressure.

Air from the compressor enters the unloader valve through an inlet port, passes through a filter and along a passage into the unloader valve chamber.

When the pressure in the reservoir is below that of the unloader, the spring loaded valve remains closed and air flows via a non-return valve into the reservoir. The non-return valve retains the pressure built up in the reservoir when the compressor is not operating.

On Clayton Dewandre valves, reservoir pressure is communicated to either a ball valve (see Fig. K13), or to a diaphragm and hollow plunger assembly (see Fig. K15); situated above the non-return valve.

#### Ball Type (see Fig. K13)

When the reservoir pressure reaches that of the unloader valve cut-out pressure, the ball-valve lifts, and air from the reservoir acting on the relay piston

opens the exhaust valve. Air continuing to enter the unloader valve from the compressor is then diverted to atmosphere.

#### Diaphragm Type (see Fig. K14)

When reservoir pressure reaches that of the valve cut-out pressure, the diaphragm assembly lifts and air from the reservoir acting upon the unloader plunger unseats the exhaust valve. Air continuing to enter the valve from the compressor is then diverted to atmosphere.

On Westinghouse valves (see Fig. K15), reservoir pressure is communicated to the pilot valve piston situated above the relay piston.

When the reservoir pressure reaches that of the unloader valve cut-out pressure, the pilot valve moves, and air from the reservoir acting on the relay piston opens the exhaust valve. Air continuing to enter the unloader valve from the compressor is then diverted to atmosphere.

## To Overhaul

Air units must be dismantled and assembled by a competent mechanic and the work done on a clean bench in a dry and dust free atmosphere.

Scrupulous attention to cleanliness will avoid undue wear and unreliable operation due to the entry of dirt.

**Clayton Dewandre** (see Fig. K13).

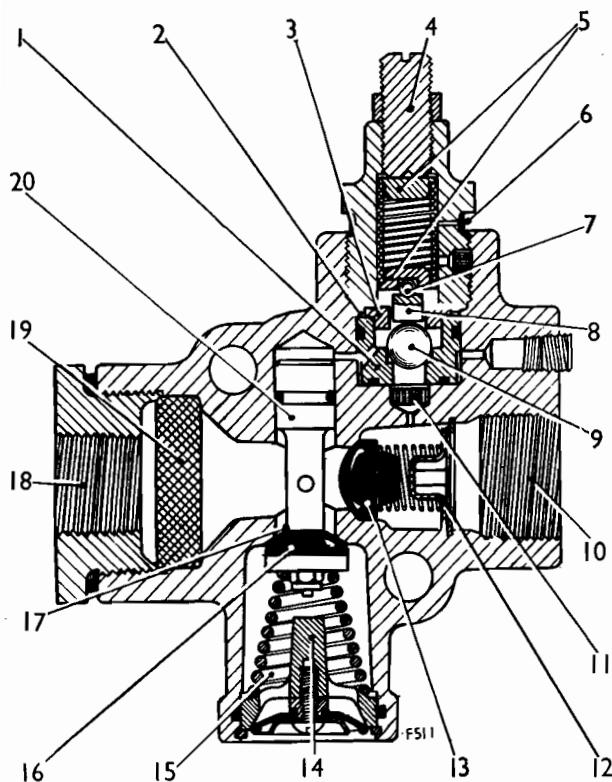
### Ball Type

Release the air from the system (see Part A).

Remove the unloader valve from the vehicle.

Unscrew the inlet port adaptor and remove the wire mesh filter.

Remove the circlip retaining the exhaust valve assembly; care is necessary during this operation as the return spring is under compression.



### Key to Numbers:—

- |                                     |                              |
|-------------------------------------|------------------------------|
| 1. LOWER SEAT—BALL VALVE            | 10. OUTLET PORT TO RESERVOIR |
| 2. BRASS SHIM                       | 11. SINTERED BRONZE FILTER   |
| 3. UPPER SEAT—BALL VALVE            | 12. SPRING GUIDE             |
| 4. PRESSURE ADJUSTING SCREW         | 13. NON-RETURN VALVE         |
| 5. SPRING SEATS—ADJUSTING SCREW     | 14. SPRING RETAINER          |
| 6. RUBBER DUST SHIELD FOR VENT HOLE | 15. RETURN SPRING            |
| 7. STEEL BALL                       | 16. EXHAUST VALVE            |
| 8. GUIDE—BALL VALVE                 | 17. BRASS SHIM               |
| 9. BALL VALVE                       | 18. INLET PORT               |
|                                     | 19. WIRE MESH FILTER         |
|                                     | 20. RELAY PISTON             |

Fig. K13 Unloader valve—Clayton Dewandre—Ball Type

Withdraw the exhaust valve spring assembly and dismantle by removing the screw from the spring retainer. Detach the rubber diaphragm together with its washer and distance piece.

Withdraw the relay piston from the body, checking that it slides smoothly in its bore without sticking. Unscrew the nut on the lower end of the piston and remove the exhaust valve and shim.

Remove the circlip retaining the non-return valve assembly and withdraw the retainer, guide, spring and rubber valve.

Without disturbing the setting of the unloader adjustment screw, unscrew the adaptor at the top of the unloader body and remove the spring and upper spring seat. Invert the unloader body to remove the lower spring seat and valve guide.

Remove the ball valve assembly by gently tapping the top of the unloader body against a piece of wood until the ball valve assembly and sintered bronze filter is dislodged.

Wash all parts in clean paraffin and allow them to dry.

Examine the rubber valves and seals for deterioration and renew if necessary. The rubber dust shield on the unloader adjustment screw adaptor should be removed to ensure that the vent hole in the adaptor is free from obstruction.

Fit new rubber "O" ring seals on the relay piston, ball valve seats and interior of the exhaust port.

Inspect the return springs for distortion or corrosion and renew if necessary.

Check the non-return valve seat for damage; also the ball and its upper and lower seats for pitting or damage. If these are defective the complete unloader assembly should be renewed. If however, this is not possible, a new ball together with upper and lower seats **must** be fitted.

**Note.**—When fitting a new ball valve assembly the following procedure is recommended to "bed" the ball between the upper and lower seatings.

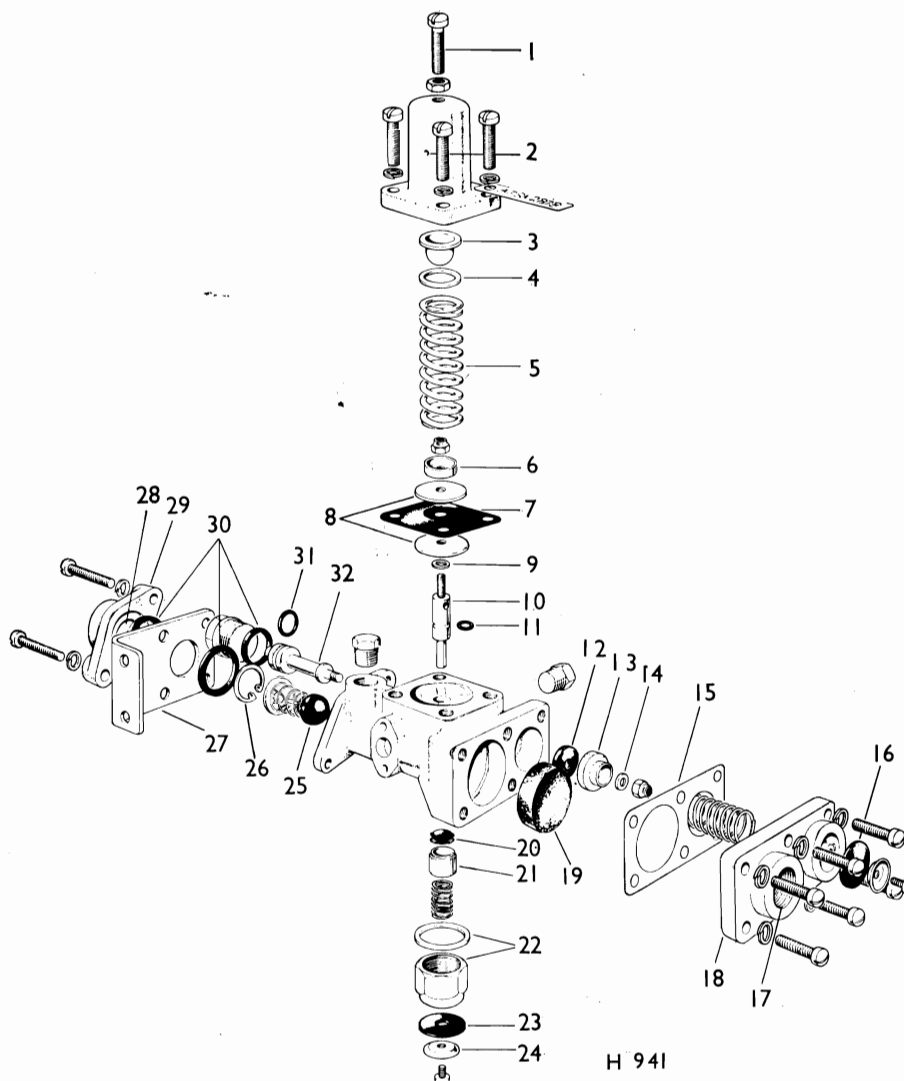
Insert the lower ball seat, without "O" rings, into position in the unloader valve body. Place the ball on the seat and fit the upper seat **without** the brass shim. Screw in the adaptor and tighten.

Remove the adaptor and ball valve assembly, thoroughly clean to remove any surplus metal, and fit new rubber "O" rings.

Assemble the unloader valve by reversing the procedure for removal noting the following:—

**Lightly** grease all moving parts.

Insert the lower ball valve seating into the unloader body, followed by the ball, shim and upper seating. The ball guide must be assembled with the recess uppermost.



### Key to Numbers:—

- |                                       |                                    |                                |
|---------------------------------------|------------------------------------|--------------------------------|
| 1. PRESSURE ADJUSTING SCREW           | 11. RUBBER "O" RING                | 22. EXHAUST NUT AND WASHER     |
| 2. VENT HOLE—TOP COVER                | 12. UNLOADER EXHAUST VALVE         | 23. DIAPHRAGM—GOVERNOR EXHAUST |
| 3. SPRING SEAT                        | 13. SPRING SEAT                    | 24. PLATE                      |
| 4. WASHER                             | 14. WASHER                         | 25. NON-RETURN VALVE ASSEMBLY  |
| 5. PRESSURE SETTING SPRING            | 15. JOINT                          | 26. CIRCLIP                    |
| 6. SPRING GUIDE                       | 16. DIAPHRAGM—UNLOADER EXHAUST     | 27. MOUNTING BRACKET           |
| 7. DIAPHRAGM                          | 17. INLET PORT FROM AIR COMPRESSOR | 28. OUTLET PORT TO RESERVOIR   |
| 8. DIAPHRAGM FOLLOWER—UPPER AND LOWER | 18. COVER                          | 29. END COVER                  |
| 9. FABRIC WASHER                      | 19. FILTER                         | 30. RUBBER SEALING RING        |
| 10. GOVERNOR PLUNGER                  | 20. INLET/EXHAUST VALVE            | 31. RUBBER "O" RING            |
|                                       | 21. VALVE SEAT AND SPRING GUIDE    | 32. UNLOADER PLUNGER           |

**Fig. K14 Unloader Valve—Clayton Dewandre Diaphragm Type**

When fitting the exhaust valve to the relay piston, make certain that the brass shim is fitted between the valve seat and flange.

Fit a new copper washer on the inlet port adaptor.  
When the unloader valve has been assembled see under "To Test" and "To Adjust".

**Clayton Dewandre** (see Fig. K14)

### Diaphragm Type

Release the air from the system (see Part A).

Remove the valve from the vehicle.

Before dismantling the unit, measure the exposed length of the adjusting screw so that the unit can be re-assembled to the same valve setting.

Slacken the adjusting screw locknut and remove the screw. Remove the screws from the top cover, restraining the cover till all tension is released from the spring. Remove the setting spring, washer and seat.

Withdraw the diaphragm assembly from the body and if necessary remove the rubber "O" ring from the governor plunger. With a suitable rod inserted into the plunger cross hole unscrew the nut. Remove the nut, spring guide, followers, diaphragm and fabric washer from the plunger.

Remove the screw retaining the governor exhaust diaphragm and detach the plate and diaphragm. Unscrew the exhaust nut and remove the washer, inlet/exhaust valve, spring and spring retainer.

Remove the screw retaining the unloader exhaust diaphragm and remove the plate and diaphragm. Remove the cover, joint, spring and seat; withdraw the filter element from the body.

Remove the large plug and rubber sealing ring. Hold a screwdriver in the slotted end of the unloader plunger, unscrew the nut from the plunger and remove the washer and valve. Withdraw the plunger and if necessary detach the rubber "O" ring.

Remove the end cover, mounting bracket and sealing rings. Extract the circlip and withdraw the complete non-return valve assembly.

Wash all parts in clean paraffin and allow them to dry.

Examine the rubber diaphragms, valves and seals for wear or deterioration and renew if necessary. The sealing face of the rubber inlet/exhaust valve should be flat and smooth. Check that the valve seats are not damaged.

Inspect the return springs for distortion or corrosion and renew if necessary.

Assembly by reversing the procedure for dismantling noting the following points:—

Lightly grease all moving parts with a barium based grease.

Fuel oil must not be allowed to come into contact with any rubber valve or seal.

Fit new rubber "O" rings on the unloader and governor plungers.

When fitting the exhaust valve on to the unloader plunger, ensure that the smooth side of the valve seat faces towards the seat in the body.

Fit the diaphragm assembly with the diaphragm

fitted between the chamfered sides of the followers and the fabric washer under the lower follower.

Check before inserting the setting spring into the top cover that the washer is located between the seat and spring.

When the valve has been assembled, see under "To Test" and "To Adjust".

### Westinghouse valve (see Fig. K15)

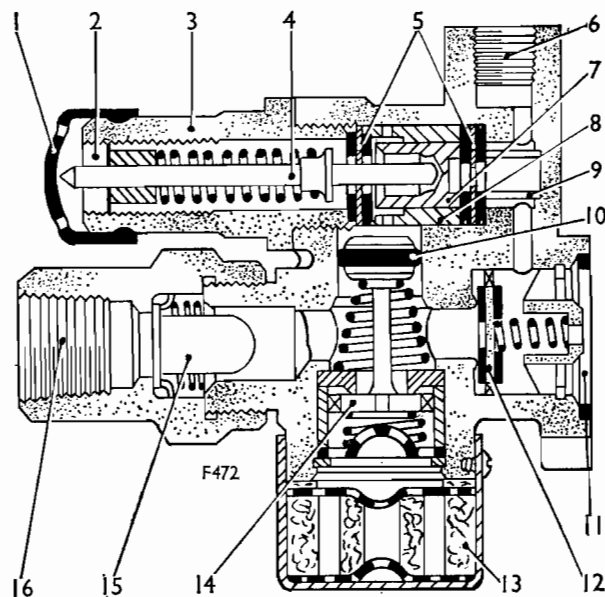
Release the air from the system (see Part A).

Remove the unloader valve from the vehicle.

Remove the control spring housing and withdraw the spring, push rod, valve seats, pilot valve, bush and filter. Check that the pilot valve slides easily in the bore of the bush without sticking. Examine the rubber valve seats for deterioration and if necessary renew.

Remove the screws retaining the exhaust silencer and remove the exposed exhaust valve circlip. Withdraw the perforated plates, spring, sleeve, exhaust valve and relay piston assembly.

Check the relay piston spring and the exhaust valve. If any signs of distortion or corrosion are present, the spring should be renewed. Check also the rubber



### Key to Numbers:—

- |                                   |                              |
|-----------------------------------|------------------------------|
| 1. RUBBER VENT CAP                | 8. PILOT VALVE BUSH          |
| 2. CONTROL SPRING ADJUSTMENT BUSH | 9. FILTER                    |
| 3. CONTROL SPRING HOUSING         | 10. RELAY PISTON             |
| 4. PUSH ROD                       | 11. OUTLET PORT TO RESERVOIR |
| 5. VALVE SEATS—PILOT VALVE PISTON | 12. NON-RETURN VALVE         |
| 6. OUTLET PORT TO AIR AUXILIARIES | 13. EXHAUST SILENCER         |
| 7. PILOT VALVE PISTON             | 14. EXHAUST VALVE            |
|                                   | 15. AIR INLET FILTER         |
|                                   | 16. AIR INLET PORT           |

**Fig. K15 Unloader valve—Westinghouse**

seal on the relay piston for deterioration and if necessary renew. The exhaust valve may be lapped lightly on to its seat using metal polish.

Remove the circlip retaining the non-return valve assembly and withdraw the spring guide, spring and non-return valve. The rubber portion of the valve should be wiped clean, or if damaged, renewed. No attempt must be made to clean the valve seat with an abrasive or cutting tool.

Unscrew the air inlet adaptor and withdraw the filter element, guide and spring.

Remove the pressure control spring housing, push rod and spring. Examine the rubber vent cap on the end of the control spring housing for deterioration, also the adjustment bush for wear, and renew if necessary.

Wash the felt pads of the exhaust silencer, pilot valve and inlet filters in clean paraffin.

The various jointing gaskets and washers if in other than perfect condition should be renewed.

Assemble by reversing the procedure for dismantling noting the following points:—

Lightly grease all moving parts. Fuel oil must **not** be allowed to come into contact with any rubber valve or piston seal.

When fitting the pilot valve bush, ensure that the holes in the bush are towards the relay piston.

When the unloader valve has been assembled, see under “**To Test**” and “**To Adjust**”.

### To Test

Charge the reservoir by running the compressor or admitting air from a shop air line (*see Section 25*).

The valve should be adjusted to operate when the pressure gauge indicates the pressures given in

Section 25. If a test gauge has been fitted in the supply line to the valve, it should give a zero or very low reading **after** the valve has unloaded.

Slowly empty the reservoir by opening the drain cock, or if a drain plug is fitted, unscrew the plug sufficiently to expose the vent hole. The valve should cut-in again at the pressure given in Section 25.

To check the valve for air leakage, close the drain cock or plug and charge the reservoir to just below the cut-out pressure before stopping the compressor. With a solution of soapy water, check that there is no escape of air through the exhaust port or vent hole. Note that on the Clayton Dewandre diaphragm type valve, there are two exhaust diaphragms. Repeat the same check but charge the reservoir to cut-out pressure. If leakage is detected, remove the valve and overhaul.

### To Adjust

The valve cut-out pressure is adjusted to the figure given in Section 25, by slackening the locknut and turning the adjusting screw, **clockwise** to **increase** and **anti-clockwise** to **decrease** the pressure. On Westinghouse valves, remove the vent cap to gain access to the adjusting bush.

When increasing the pressure, screw down just beyond the desired point and then turn back, so avoiding any twisting of the spring that will affect the setting; this will not be necessary on a diaphragm operated type valve.

There is no adjustment for cut-in pressure, and if this is low, the valve must be removed from the vehicle for overhaul.

It is important that the reservoir pressure does not fall below the cut-in pressure, but it is unimportant whether the actual cut-in pressure is slightly higher than that quoted in Section 25.

## Section 10

### BRAKE VALVE UNIT

(*See Figs. K16, K17 and K18*)

#### Method of Operation

The operation of the single, dual and dual concentric brake valve units is basically the same.

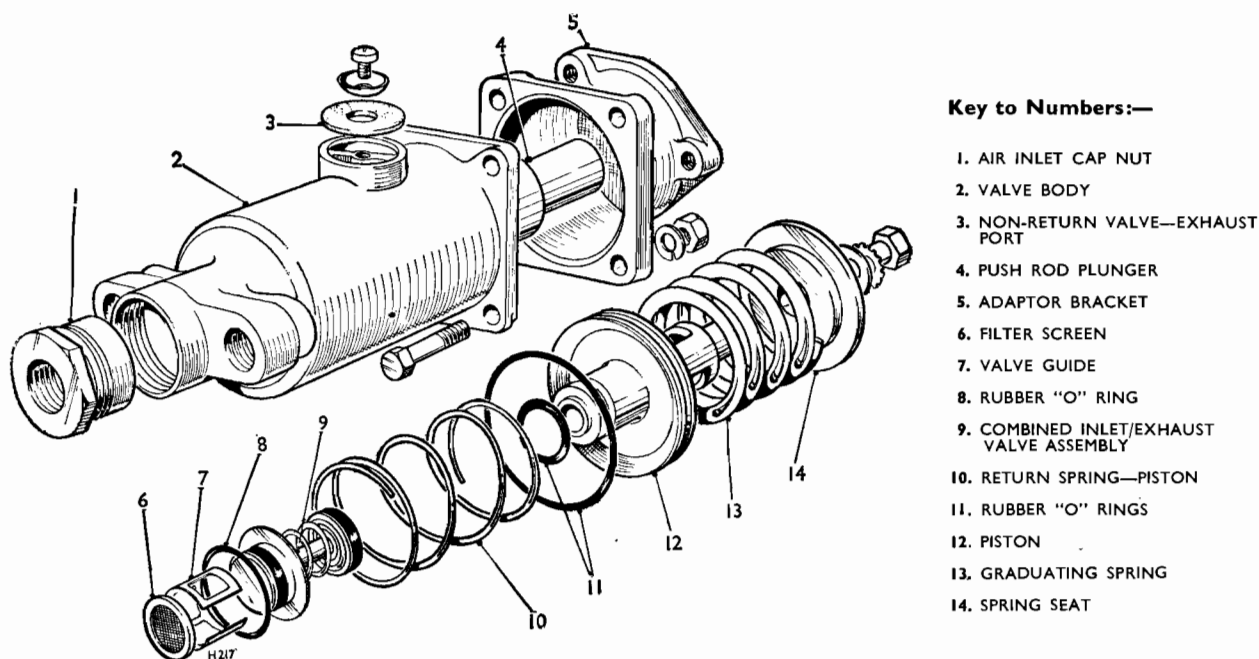
Movement of the brake pedal is transmitted through a main graduating spring to the piston which bears upon the inlet valve permitting compressed air to flow to the brake air chambers.

Whilst the compressed air is being supplied to the brake chambers, pressure builds up below the piston until it is sufficient to overcome the mechanical force applied to the graduating spring; the piston thus

rises and the inlet valve closes to shut off further supply. Simultaneously, the exhaust valve makes contact with the piston to prevent loss of pressure and balance is achieved in the system.

Further brake application causes the above cycle of operation to be repeated, resulting in higher brake line pressures.

Release of the brake pedal allows the air inlet valve to open, thereby exhausting the brake air chambers to atmosphere.



#### Key to Numbers:—

1. AIR INLET CAP NUT
2. VALVE BODY
3. NON-RETURN VALVE—EXHAUST PORT
4. PUSH ROD PLUNGER
5. ADAPTOR BRACKET
6. FILTER SCREEN
7. VALVE GUIDE
8. RUBBER "O" RING
9. COMBINED INLET/EXHAUST VALVE ASSEMBLY
10. RETURN SPRING—PISTON
11. RUBBER "O" RINGS
12. PISTON
13. GRADUATING SPRING
14. SPRING SEAT

Fig. K16 Single brake valve

#### To Remove

Release the air from the system (*see Part A*).

Brush away dirt from the pipe unions and disconnect the unions from the valve unit; plug the ends of the pipes to prevent the ingress of foreign matter.

It is not necessary to disconnect the push rod fork end from the pedal lever when removing the brake valve unit.

Disconnect the rubber gaiter from the valve and slide the gaiter along the push rod.

Remove the valve unit from the pedal bracket; detach the rubber gaiter from the push rod.

#### To Dismantle

Remove all dirt and grease from the exterior of the valves and proceed as follows:—

Prior to dismantling, mark the adaptor bracket and valve body to show their correct relationship to one another.

Remove the adaptor bracket from the valve body and withdraw the plunger from the adaptor. **On Westinghouse dual brake valves**, remove the circlips from the pivot pin and drive out the pin to release the compensating lever from the push rod plunger. Remove if necessary, the plunger bush from the adaptor with a copper drift.

#### Single and Dual Brake Valve Units (*see Figs. K16 and K18*)

Having removed the adaptor bracket from the body of the valve, dismantle as follows:—

Remove the piston assembly or assemblies. Do not dismantle the piston(s) further unless it is found necessary to renew any of the parts. **On the dual brake valve** retain the shims under the main spring.

Remove the rubber check valve from the exhaust port by removing the screw.

Unscrew the inlet nut and remove the inlet/exhaust valve assembly, inlet valve guide and the filter screen (when fitted).

**Note.**—**On the dual brake valve**, each inlet/exhaust valve assembly is retained by a valve guide and circlip. Remove both circlips and withdraw the valve guides with the inlet/exhaust valve assembly from the lower portion of the valve body.

Detach each valve assembly from its guide and remove the rubber "O" rings from the guides and valve body.

#### Dual Concentric Brake Valve Unit (*see Fig. K17*)

Having removed the adaptor bracket from the valve body of the valve, dismantle as follows:—

Detach the push rod plunger. Remove the graduating spring assembly; upper piston and spring from the valve body; detach the rubber "O" ring and spring damper ring from the piston.

Unscrew the setbolt retaining the graduating spring and remove the retainer, spring, abutment washer and thrust bolt. The thrust ball located in the thrust bolt should not be removed.

Hold the valve carrier against the force of the lower piston return spring and remove the stop bolt from the valve body. Withdraw the carrier, also the lower piston and return spring from the valve body; detach the rubber "O" rings from the carrier and piston.

Dismantle the upper inlet/exhaust valve assembly by removing the circlip from the valve carrier and withdrawing the guide, spring, retainer and valve. Remove the rubber "O" ring from the stem of the valve.

Remove the end cover from the valve body; detach the rubber "O" ring and the lower inlet/exhaust valve. Remove the spring, retainer and the rubber "O" ring from the valve.

### To Assemble

Reverse the sequence for dismantling, giving attention to the following instructions:—

Clean all metal parts in cleaning solvent paying particular attention to the piston(s), the valve carriers (on the dual concentric brake valve) and the graduating spring retainer(s) for damage, if necessary renew.

Inspect the exhaust seating on the end of the piston(s). If slightly worn, the seat(s) can be lightly refaced by lapping on a piece of crocus cloth on a flat surface. If the seat(s) is/are damaged, or worn excessively, the piston(s) should be renewed.

Examine the piston bore(s); a new valve body should be fitted if wear or scoring has occurred.

Renew the rubber inlet/exhaust valves and all rubber seals and "O" rings.

Examine the main graduating spring(s), piston(s) and valve return spring(s), renew if distortion or corrosion is evident. If a spring is faulty in the **dual brake valve**, renew both valve springs.

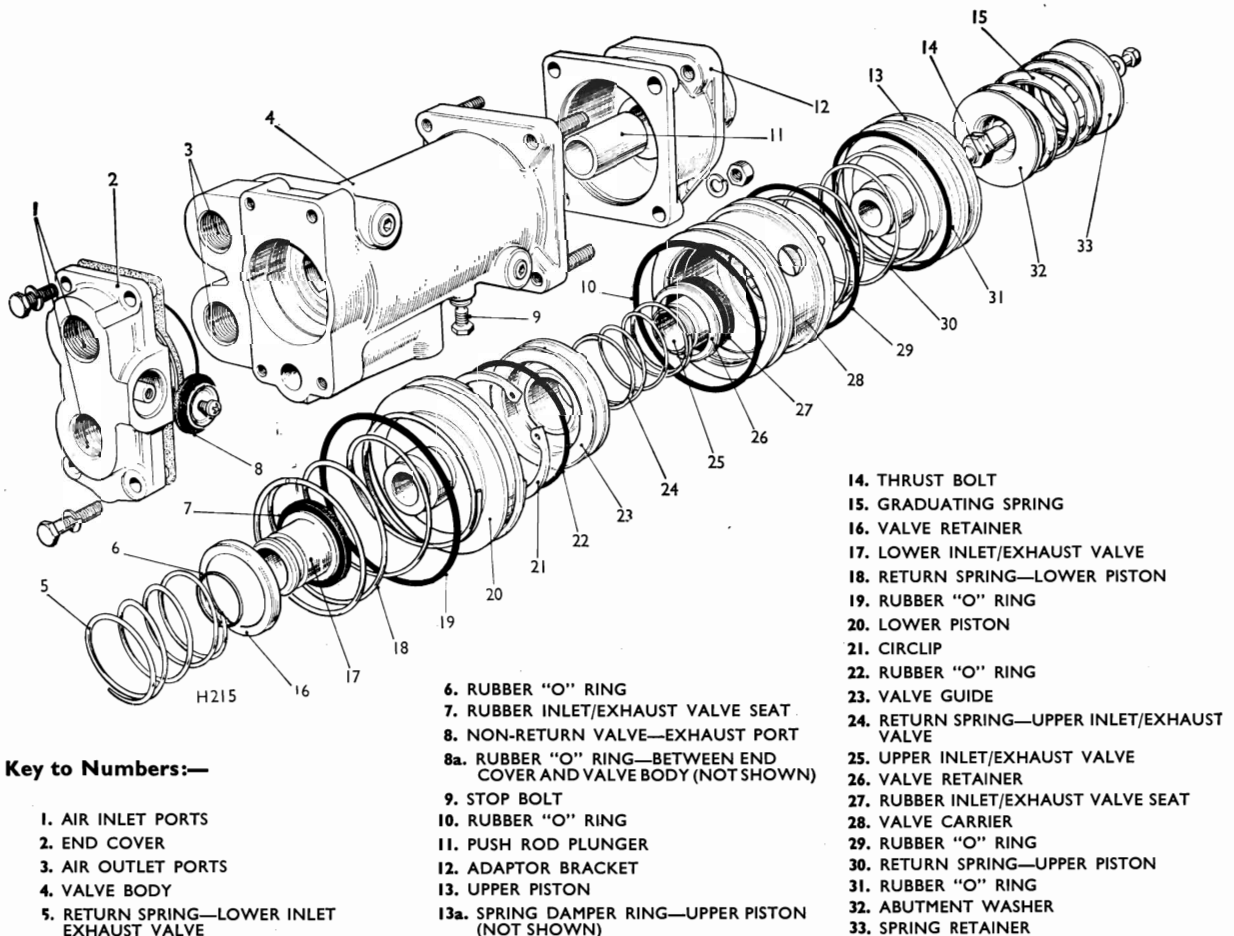


Fig. K17 Dual concentric brake valve

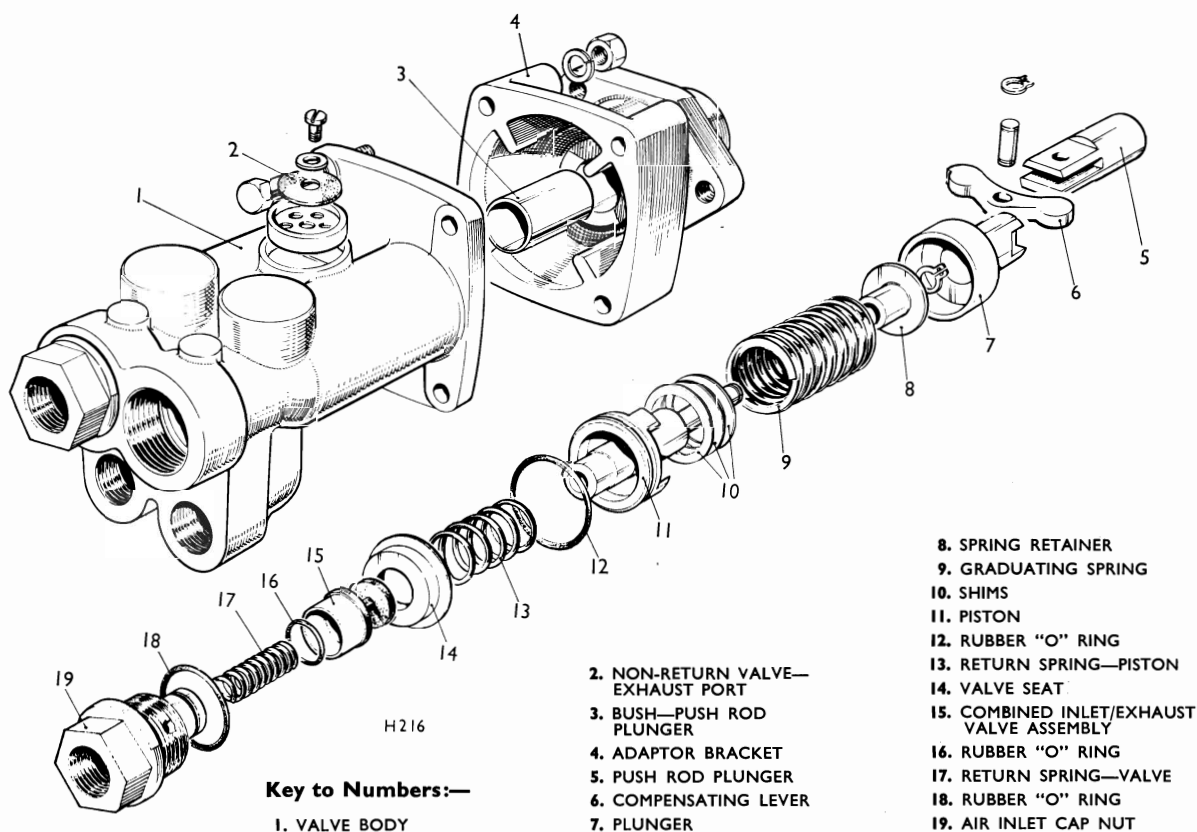


Fig. K18 Dual brake valve

The piston bore(s), springs and push rod plunger should be smeared on initial assembly with barium based grease. Apart from the initial greasing the valve does not require further lubrication.

If it is necessary to renew the bush in the adaptor bracket, press the bush into the adaptor until it is flush with the casing.

If the main graduating spring(s) has/have been renewed, test the valve as follows:—

#### To Test

##### Dual and Dual Concentric Brake Valves

If facilities are available, fit an applicable and accurate pressure gauge(s) in the pipe lines between the brake valve and brake air chambers.

With the system charged, depress the brake pedal to several positions between fully released and fully applied. Check that the delivered pressure varies immediately in accordance with the position of the brake pedal, and that in each position the valves deliver from the outlet port(s) the same pressure to within 5 lb. per sq. in. (0.35 Kg. per sq. cm.) of each other.

To test the brake valve unit when removed from the chassis, connect an air supply to both inlet ports and connect accurate pressure gauges to the delivery ports. The pressures registered should be within the figure quoted in the previous paragraph.

#### Single and Dual Brake Valves

Check that the pressure gauge(s) registers zero immediately the brake pedal is fully released. If these results are not obtained ensure that the plunger works freely before dismantling the valve.

#### All Types

Test for leakage, with the pedal in the fully released and fully applied positions, by coating the exhaust non-return valve with soap solution.

If **any** leakage occurs when the brakes are released or if leakage **in excess of a one inch soap bubble in five seconds** occurs when the brakes are applied, the lower inlet/exhaust valve assembly may be faulty. Remove the assembly and inspect for damage. Renew parts where necessary. If the assembly is found to be undamaged, the brake valve should be removed and repaired or a new valve should be fitted.

### To Adjust

With the brake valve fitted to the chassis and connected up, charge the reservoirs.

Operate the brake pedal once and release it completely. The pressure(s) indicated on the pressure gauge should immediately fall to zero.

If the pressure does not fall to zero, disconnect the fork end of the linkage from the push rod and adjust

the linkage by means of the fork end so that the tip of the push rod is just in contact with the plunger cavity. Any pressure exerted on the main graduating spring via the linkage, or conversely any play between the plunger and rod end should be eliminated.

If the valve does not graduate the delivered pressure satisfactorily, promptly check that the bleed hole(s) in the valve is/are not restricted.

## Section 11 REGULATING VALVE AND PRESSURE REDUCING VALVE

### Regulating Valve (see Fig. K19)

#### Introduction

A **regulating valve** is fitted in the pipe line between the unloader valve and the air-assisted parking brake reservoir and serves to ensure that operation of the parking brake does not deplete the main brake air supply below a safe minimum.

A **second regulating valve** is also used when a vehicle is fitted with an air-operated inter-axle differential lock unit. The valve serves to protect the main brake system.

#### Method of Operation

The valve comprises a regulating spring, preloaded to the required setting, which acts on the diaphragm assembly controlling the movement of an exhaust valve situated between the inlet and outlet ports.

When reservoir pressure acting on the underside of the diaphragm overcomes the spring setting, the diaphragm lifts, thus opening the exhaust valve. Compressed air is then available to flow to the air assisted parking brake reservoir and, when fitted, to the differential lock unit.

The reverse action to these operations returns the exhaust valve to its seating, holding the air pressure at the pre-set pressure of the spring.

#### To Dismantle

##### Clayton Dewandre and Westinghouse (see Fig. K19)

Release the air from the system (see Part A) and remove the unit from the chassis; plug the ends of the pipes to prevent the ingress of foreign matter.

Remove the setscrews securing the spring cage (care should be taken as the cage will be under spring pressure) and remove the cage together with the adjusting screw and locknut.

Withdraw the dampener, spring and seat from the cage, then carefully lift the diaphragm and remove the assembly from the body.

#### To Assemble

Thoroughly clean all parts, examine and renew any part that is worn or damaged, then reverse the procedure for dismantling noting the following:—

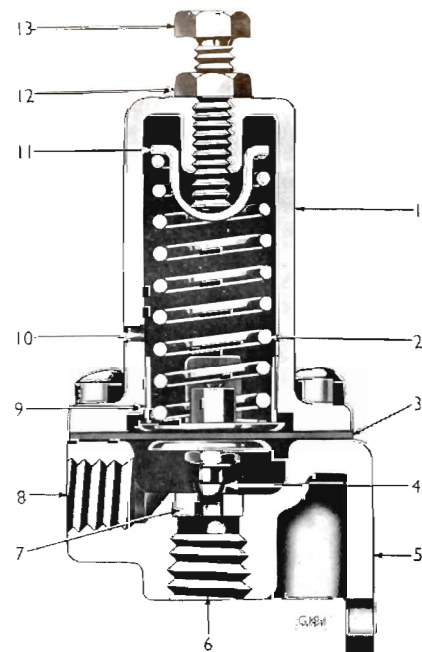
Examine the valve and valve seat for wear, if grooved or pitted, renew both the valve and seat.

Insert the diaphragm, if worn or damaged, renew. Fit a new dampener if worn or cracked.

When assembling, ensure that the dampener is fitted correctly with its ears adjacent to the spring, also that the well of the spring upper seat is inserted inside the top of the spring.

#### To Test

To test for air leakage, run the engine at idling speed to charge the air pressure system. Apply a solution of soap and water to the parts; leakage may then be detected by the appearance of bubbles.



#### Key to Numbers:—

- |                               |                       |
|-------------------------------|-----------------------|
| 1. SPRING CAGE                | 7. EXHAUST VALVE SEAT |
| 2. DIAPHRAGM OPERATING SPRING | 8. INLET PORT         |
| 3. DIAPHRAGM                  | 9. DAMPER             |
| 4. EXHAUST VALVE              | 10. VENT HOLE         |
| 5. VALVE BODY                 | 11. SPRING UPPER SEAT |
| 6. OUTLET PORT                | 12. LOCKNUT           |
|                               | 13. ADJUSTING SCREW   |

Fig. K19 Regulating valve

Check the valve for leakage at the small vent hole in the spring cage. Any leakage here will indicate a faulty diaphragm which must be renewed.

Check also for air leakage from the outlet port, noting the following:—

Release the air from the system (*see Part A*), then disconnect the pipe connection from the outlet port.

Start the engine and run it until the main air system is charged to approximately 10 lb. per sq. in. (0.70 Kg. per sq. cm.) below the correct operating pressure of the valve (*see Section 25*).

With the delivery pressure on the valve, coat the exposed outlet port with soap suds to detect leakage; leakage of a three-inch soap bubble in three seconds is permissible. If in excess of this, dismantle the unit and examine the valve and seating.

### To Adjust

If the valve setting has been disturbed, mount the valve on to the chassis and connect the air pressure pipe line. Screw the adjusting screw into the maximum depth, i.e., until the head bears against the locknut.

Charge the air pressure system to the valve setting and stop the compressor.

Slowly **unscrew** the valve adjusting screw until a sudden drop is registered on the air pressure gauge thus indicating that the valve has opened. Secure the locknut at this setting.

Release the pressure from the system; operate the compressor and verify that the valve opens at the pressure given in Section 25.

If an adjustment is required, **screw in** the adjusting screw to **increase** the pressure, **unscrew** to **decrease** the pressure.

Finally, lock the adjusting screw with the locknut and test the valve for air leakage.

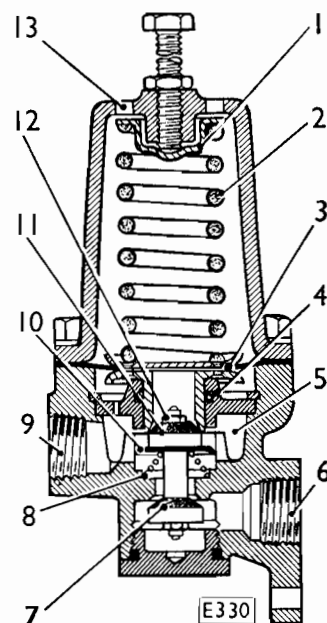
## Pressure Reducing Valve (*see Figs. K20 and K21*)

### Introduction

A **pressure reducing valve** is provided on certain **six- and eight-wheeled** vehicles with four-spring suspension and is operative on the brake chambers of the 1st driving axle. The valve reduces the line pressure during brake application to a figure slightly below that of the brake air chambers fitted to the front axle and trailing rear axle.

The valve can be either diaphragm or piston type.

A similar type of **pressure reducing valve** on certain **six- and early eight-wheeled** vehicles is fitted in the pipe line between the hand brake valve and brake air chambers. The valve ensures that the line pressure to the hand brake air chambers is reduced to a figure below that required for foot brake application and prevents "locking" of the wheels when the hand brake is applied.



### Key to Numbers:—

1. REGULATING SPRING GUIDE
2. REGULATING SPRING
3. DIAPHRAGM ASSEMBLY
4. GUIDE PLATE WITH METERING HOLE
5. PRESSURE CHAMBER IN BODY
6. INLET PORT
7. INLET VALVE
8. INLET AND RELEASE VALVE RETURN SPRING
9. OUTLET PORT
10. RELEASE VALVE GUIDE
11. RELEASE VALVE
12. NUT SECURING RELEASE VALVE
13. VENT HOLE

Fig. K20 Reducing valve—Clayton Dewandre

### Method of Operation

When air inlet pressure overcomes the regulating spring the air inlet valve closes. Should the air pressure rise above the regulating spring setting on the **Clayton Dewandre valve**, the release valve seat lifts and excess air is vented to atmosphere.

During brake application, a drop in pressure occurs, as air is used, through the outlet port and the regulating spring re-asserts itself so that the inlet valve reopens until the required pressure is again restored on the low pressure side.

### To Dismantle

Release the air from the system (*see Part A*) and remove the unit from the chassis; plug the ends of the pipes to prevent the ingress of foreign matter.

### Clayton Dewandre (*see Fig. K20*)

Unscrew the setscrews securing the spring cage, restraining the cage until all tension is released from the spring. Do not disturb the adjusting screw and locknut.

Detach the regulating spring and its guide from the cage.

Carefully lift the diaphragm assembly from the body.

Remove the circlip retaining the guide plate and withdraw the plate from the body. Detach the rubber grommet from the guide plate.

Unscrew the plug from the base of the valve and remove the rubber grommet from the plug.

Remove the nut securing the release valve to the stem and detach the valve. The joint under the valve must be retained.

Withdraw the inlet valve and stem then remove the spring from the body.

#### Westinghouse (see Fig. K21)

Unscrew the inlet valve cap from the body and remove the copper washer.

Extract the valve disc and the spring.

Remove the nuts and spring washers to release the bottom cover from the body.

Do not interfere with the adjusting screw or its locknut unless necessary.

Remove the regulating spring and the piston with its packing.

#### To Assemble

Thoroughly clean all parts, examine and renew any part that is worn or damaged, then reverse the procedure for dismantling noting the following:—

#### Clayton Dewandre (see Fig. K20)

Examine the rubber faces of the valves for signs of deterioration or wear and renew if necessary.

The rubber grommets if in other than perfect condition must be renewed.

Inspect the diaphragm assembly and guide plate for damage or deterioration also the bearing surfaces. Renew any parts showing signs of wear or scoring.

Examine the small metering hole in the guide plate and ensure that it is not obstructed.

When assembling, apply a smear of oil to the bearing surfaces of the diaphragm assembly and guide plate.

#### Westinghouse (see Fig. K21)

Examine the piston and bore for signs of wear or scoring and if necessary renew.

The regulating and inlet springs should be inspected for signs of corrosion or distortion and if in other than perfect condition renewed.

When fitting the piston, fit new packing on the piston with the lips of the packing facing towards the crown of the piston. Lightly grease both piston and packing prior to assembly.

Renew the valve disc; if the valve seat is pitted and requires recutting, consult the makers.

#### To Test

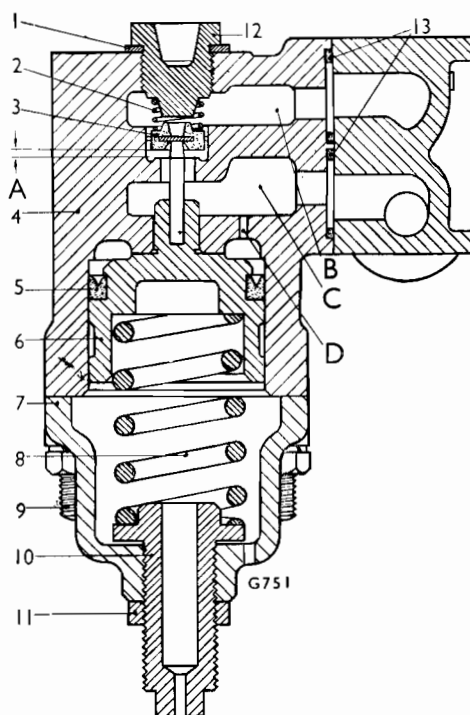
To test for air leakage, run the engine at idling speed to charge the air pressure system. Apply a solution of soap and water to the parts; leakage may then be detected by the appearance of bubbles.

#### Clayton Dewandre (see Fig. K20)

Check for air leakage from the pipe unions and vent holes in the spring cage. Leakage from the vent holes will indicate a faulty diaphragm which must be renewed.

#### Westinghouse (see Fig. K21)

Check for air leakage from the pipe unions, also at the breather hole in the adjusting screw. If leakage is detected from the breather hole, dismantle the valve and renew the packing.



#### Key to Letters and Numbers:—

- A. NOMINAL VALVE LIFT 3/32 in. (2.4 mm.)
- B. INLET PORT
- C. OUTLET PORT
- D. BY-PASS PORT
- 1. COPPER WASHER
- 2. SPRING FOR INLET VALVE DISC
- 3. INLET VALVE DISC
- 4. VALVE BODY
- 5. PISTON PACKING
- 6. PISTON
- 7. BOTTOM COVER
- 8. REGULATING SPRING
- 9. STUD, NUT AND SPRING WASHER SECURING 7 AND 4
- 10. ADJUSTING SCREW
- 11. LOCKNUT
- 12. VALVE CAP
- 13. GASKETS (NOT FITTED ON PIPE LINE MOUNTED VALVE)

Fig. K21 Reducing valve—Westinghouse

**To Adjust**

**Clayton Dewandre and Westinghouse** (see Figs. K20 and K21)

Before fitting the reducing valve to the chassis, it must be adjusted as follows:—

Connect to the inlet port an air supply with gauge capable of registering pressures up to 80 lb. per sq. in. (5.6 Kg. per sq. cm.).

Connect to the outlet an accurate gauge capable of

reading up to at least 60 lb. per sq. in. (4.2 Kg. per sq. cm.).

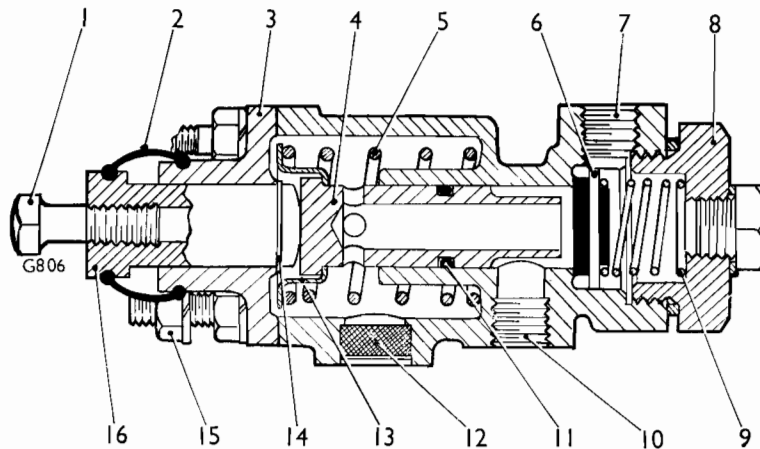
The setting of the regulating spring should then be adjusted by means of the adjusting screw so that the reducing valve delivers air at the correct operating pressure given in Section 25.

To **increase** the pressure, **screw in** the adjusting screw; **unscrew** to **decrease** the pressure.

Finally, lock the adjusting screw with the locknut, fit the valve to the chassis and test for air leakage.

**Section 12****CONTROL VALVE—AIR ASSISTED PARKING BRAKE**

(See Figs. K22, K23 and K24)

**Key to Numbers:—**

- 1. ADJUSTING SETSCREW
- 2. GAITER
- 3. END COVER
- 4. HOLLOW PLUNGER
- 5. RETURN SPRING

- 6. INLET-EXHAUST VALVE
- 7. INLET PORT
- 8. SCREW CAP
- 9. RETURN SPRING
- 10. OUTLET PORT
- 11. SEALING RING

- 12. EXHAUST PORT
- 13. SPRING RETAINER
- 14. CIRCLIP
- 15. SECURING NUT FOR MOUNTING BRACKET
- 16. END COVER PLUNGER

Fig. K22 Typical parking brake control valve—Clayton Dewandre

**Method of Operation**

The control valve is mounted in such a position that movement of the hand lever causes the valve to operate.

When the hand lever is moved to apply the brakes, compressed air is allowed through the valve by movement of the operating plungers (or piston) and transmitted to the brake air chambers.

When the brakes are held applied by the pawl and ratchet or when the hand lever is moved to the released position, air pressure is released from the brake chambers and exhausted through the control valve.

**To Overhaul**

Empty the air pressure system (see Part A).

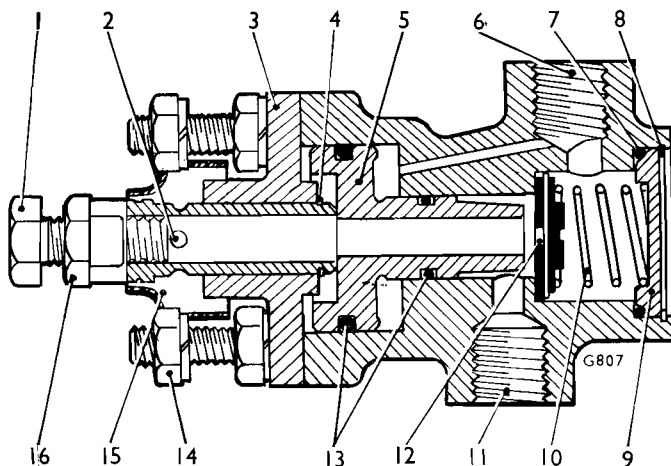
Disconnect the pipe unions from the valve and plug the ends of the pipes to prevent the ingress of foreign matter.

Remove the valve from its mounting and brush off any dirt.

**Clayton Dewandre** (see Fig. K22).

Remove the gaiter from the end cover and plunger and detach the end cover from the valve body.

Remove the circlip retaining the plunger in the end cover and withdraw the plunger. **Do not remove the adjusting screw unless the parts are damaged.**



#### Key to Numbers:—

1. ADJUSTING SETSCREW
2. EXHAUST VENT PLUNGER
3. END COVER
4. CIRCLIP
5. PISTON
6. INLET PORT
7. SEALING RING
8. CIRCLIP
9. END CAP
10. RETURN SPRING
11. OUTLET PORT
12. INLET-EXHAUST VALVE
13. PISTON SEALING RINGS
14. SECURING NUT FOR MOUNTING BRACKET
15. GAITER
16. LOCKNUT—PLUNGER

Fig. K23 Early type parking brake control valve—Westinghouse

Withdraw the hollow plunger assembly and spring from the body and remove the plunger sealing ring and the spring retainer.

Remove the screw cap, washer, spring and inlet/exhaust valve.

Remove the rubber non-return valve from the exhaust port by removing the screw and retaining washer.

Wash all metal parts in cleaning solvent and allow to dry.

Wipe all rubber parts with a clean cloth.

Examine the body for cracks or other damage, paying particular attention to the plunger bore and the valve seat.

Check the valve plunger for wear and scoring and ensure that it moves freely in the body.

Inspect the rubber faces of the inlet-exhaust valve for deterioration.

Check both springs for distortion or corrosion.

Examine the end cover for damage and its bore for scoring. Also check that the plunger is not scored and moves freely in the cover.

Renew any parts found defective during inspection.

When assembling, reverse the procedure for dismantling, noting the following:—

Insert the inlet/exhaust valve into the body with the **flat** rubber surface towards the seat.

Fit a **new** washer on the cap before screwing it into the body.

Lightly smear with grease the plungers and plunger bores.

Check that the gaiter beads are correctly located in the grooves in the end cover and plunger.

#### Westinghouse—Early Type (see Fig. K23)

Detach the gaiter from the end cover and plunger then remove the cover from the valve body.

Remove the circlip from the plunger and withdraw the plunger from the end cover. **Do not remove the adjusting screw unless the parts are damaged.**

#### Westinghouse—Late Type (see Fig. K24)

Prior to dismantling, mark the spring cage and valve body to show their correct relationship to one another.

Remove the end cover and spring cage from the valve body and detach the retainer and spring.

Remove the circlip retaining the hollow plunger in the end cover and remove the plunger with rubber gaiter. **Do not remove the adjusting screw unless the parts are damaged.**

#### Both Types

Remove the circlip retaining the end cap in the valve body, taking care as the cap holds the inlet/exhaust valve return spring under compression.

Withdraw the cap, sealing ring, return spring and inlet/exhaust valve.

Push the piston out of the body and remove the sealing rings.

Wash all metal parts in cleaning solvent and allow to dry. Ensure that the exhaust holes in the end of the plunger are clean and free from obstruction.

Wipe all rubber parts with a clean cloth.

Examine the body, and when applicable, the spring cage for cracks or other damage, paying particular attention to the piston bore and the valve seat.

Check the end cover for damage and its bore for scoring.

Inspect the piston and the plunger for wear and scoring and ensure that they move freely in their respective bores in the body and end cover.

Examine the rubber faces of the inlet/exhaust valve for deterioration, also the piston and end cap sealing rings.

Check the return spring(s) for corrosion or distortion.

Renew any parts found defective during inspection. When assembling, reverse the procedure for dismantling, noting the following:—

Insert the inlet/exhaust valve into the body with the **flat** rubber surface towards the seat.

Lightly smear with barium based grease the piston and plunger and their respective bores.

#### All Types

Secure the valve to its mounting and connect up the pipe unions.

If necessary, reset the adjusting screw with the brake lever in the fully released position. Adjust the clearance between the screw and lever to measure 0.012 in. (0.305 mm.). When setting the gap on the early **Westinghouse** type valve, ensure that the plunger is pulled fully out.

After fitting, see under "To Test."

#### To Test

Charge the air pressure system.

Move the brake lever from the fully released to the fully applied positions to check that the brakes are applied satisfactorily.

Check that air pressure is released from the brake chambers when the brakes are held applied by the pawl and ratchet.

Apply soap solution to the valve body, screw (or end) cap and pipe connections.

With the brake in the released position, check at the **exhaust port** on **Clayton Dewandre** valves or the **plunger exhaust drillings** on **Westinghouse** valves for air leakage. No leakage is permissible. Any leakage indicates that the inlet valve or seat is defective.

With the brake in the fully applied position, again apply the soap solution and check for leakage. No leakage is permissible. Any leakage from the exhaust port (or plunger) indicates that the exhaust valve or seat is defective. Check also the **plunger sealing ring** on **Clayton Dewandre** valves or the **piston sealing rings** on **Westinghouse** valves.

If the tests indicate defective parts or loose connections, these must be rectified.

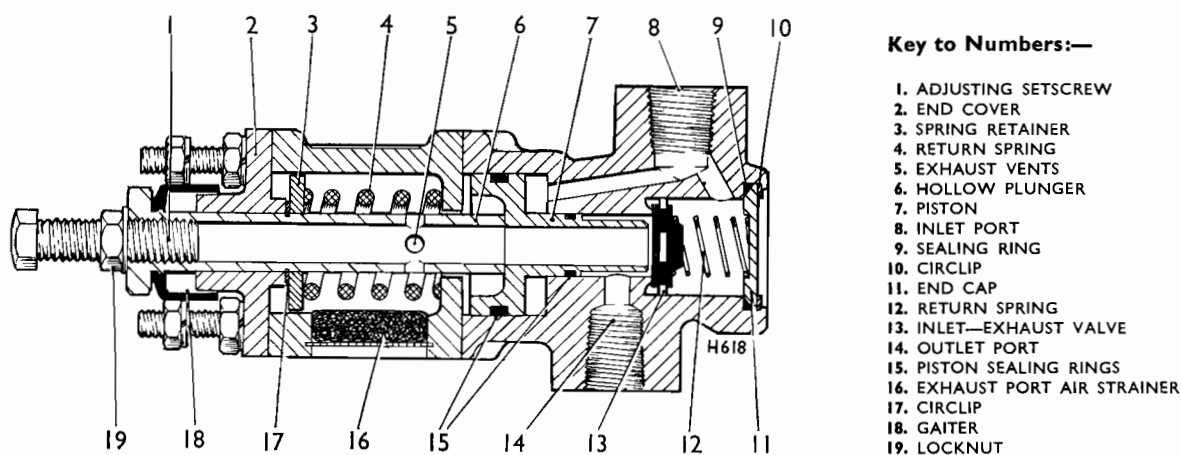


Fig. K24 Late type parking brake control valve—Westinghouse

## Section 13

## AUXILIARY BRAKE HAND CONTROL VALVE

(See Fig. K25)

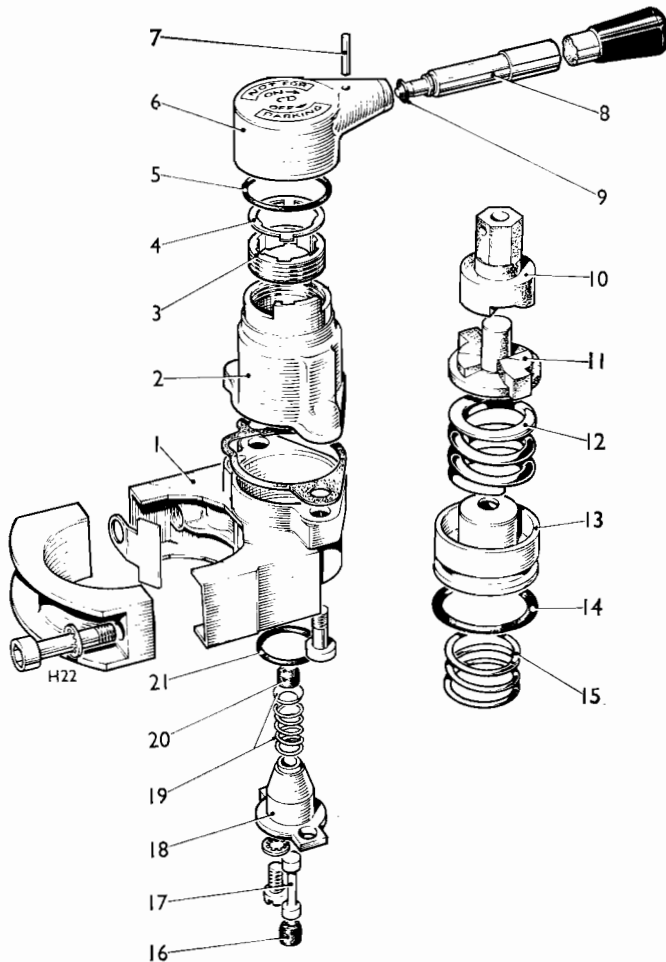
#### Method of Operation

The valve is mounted on the instrument binnacle and provides independent brake operation on the tractor front axle(s) and for a trailer with air brakes.

Initial operation of the handle moves a cam and pressure is thereby applied to the piston. Movement

of the piston moves the exhaust valve, causing it to close to atmosphere.

Further movement of the handle opens the air inlet valve and compressed air passes to the delivery port.

**Key to Numbers:—**

1. VALVE BODY
2. COVER
3. ADJUSTING RING
4. LOCKWASHER—ADJUSTING RING
5. SEALING RING
6. VALVE HEAD
7. TENSION PIN
8. HANDLE
9. SEALING RING
10. CAM FOLLOWER
11. CAM
12. GRADUATING SPRING
13. PISTON
14. SEALING RING—PISTON
15. RETURN SPRING—PISTON
16. INLET VALVE RUBBER
17. VALVE STEM
18. INLET VALVE SEAT
19. VALVE SPRING AND GUIDE
20. EXHAUST VALVE RUBBER
21. SEALING RING—INLET VALVE SEAT

**Fig. K25 Auxiliary brake hand control valve****To Dismantle**

Release the air from the brake system (*see Part A*).

Remove the unit from its mounting and plug the ends of the pipes to prevent the ingress of foreign matter.

Drive out the tension pin from the valve head and remove the handle and sealing ring.

Detach the valve head and remove the sealing ring and the adjusting ring lockwasher.

Remove the screws securing the cover to the valve body and remove the cover and gasket. Remove the cam, cam follower and unscrew the adjusting ring.

Withdraw the pressure graduating spring, piston assembly and return spring from the valve body; remove the sealing ring from the piston.

Remove the screws from the bottom of the body securing the combined inlet and exhaust valve assembly; withdraw the assembly and sealing ring.

Insert a setscrew or other suitable object into the inlet port and hold the valve on its seat.

Depress the guide and spring and remove the exhaust valve rubber from its stem. Pass the stem through the valve seat and remove the stem and inlet valve rubber.

**To Assemble**

Thoroughly clean all metal parts in cleaning solvent, examine and renew any part that is worn or damaged, then reverse the dismantling procedure, noting the following points.

Inspect the springs for signs of corrosion or distortion and renew if necessary.

If either the inlet or exhaust valve rubbers are damaged, fit new rubbers.

Prior to assembly, fit new rubber sealing rings in position on the inlet valve seat and piston; smear them and the bore in the body with a rubber grease.

Screw in the adjusting ring flush with the cover and, before assembly, smear the cover bore, cam and cam follower with a barium based grease.

Renew the paper joint between the cover and body.

### To Test

Check that the valve is operating correctly, by connecting an accurate pressure gauge into a convenient point in the pipe line.

Move the handle to several positions between "fully applied" and "released" and check that the delivered pressure varies immediately with the position in which the handle is held; then with the handle in the fully applied position, the test gauge should register the pressure specified in Section 25 with the reservoir fully charged.

Test the exhaust port with a solution of soap and water with the brakes released and similarly with the brakes applied. Leakage with the handle in the fully released position is not permissible but leakage not exceeding a one-inch soap bubble in 5 seconds is

permitted with the handle in the fully applied position. Excessive leakage will indicate that the valves or valve seats must be cleaned or renewed.

### To Adjust

If the delivery pressure of the control valve when fully applied is below or above the pressure given in Section 25, adjust as follows:—

Remove the valve head and adjusting ring lock-washer.

Rotate the adjusting ring **clockwise** to **increase** the pressure or **anti-clockwise** to **decrease** the pressure. Turning the adjusting ring one notch will raise or lower the delivered pressure by approximately 5 lb. per sq. in. (0.35 Kg. per sq. cm.).

After adjustment, refit the lockwasher, valve head, handle and tension pin.

## Section 14

## RELAY VALVE

(See Fig. K26)

### Introduction

The purpose of the relay valve is to speed up the operation of the brakes both during application and release in conjunction with the auxiliary brake hand control valve.

### Method of Operation

When the hand control valve is moved to the "ON" position, air pressure depresses the diaphragm and opens the supply valve to admit air to the brake chambers.

As soon as air pressure in the brake chambers is equal to the pressure above the diaphragm, the supply valve and exhaust passage closes and a balanced pressure is maintained each side of the diaphragm.

Further brake application will result in a corresponding increase in the air pressure delivered and a new point of balance will be achieved in the system.

### Key to Numbers:—

- |  |                                    |
|--|------------------------------------|
| 1. COVER                                   | 9. AIR INLET CAP NUT               |
| 2. DISTANCE PIECE (Westinghouse)           | 10. RUBBER "O" RING                |
| 3. DIAPHRAGM                               | 11. SUPPLY VALVE RETURN SPRING     |
| 4. DIAPHRAGM GUIDE (Clayton Dewandre)      | 12. SUPPLY VALVE (Westinghouse)    |
| 5. DIAPHRAGM GUIDE RING (Clayton Dewandre) | 13. SEAT RETAINING SPRING          |
| 6. ADAPTOR                                 | 14. RUBBER "O" RING AND VALVE SEAT |
| 7. EXHAUST STRAINER                        | 15. VALVE BODY                     |
| 8. SUPPLY VALVE (Clayton Dewandre)         | 16. DIAPHRAGM GUIDE (Westinghouse) |
|  | 17. RUBBER "O" RING                |
|  | 18. DIAPHRAGM RING                 |

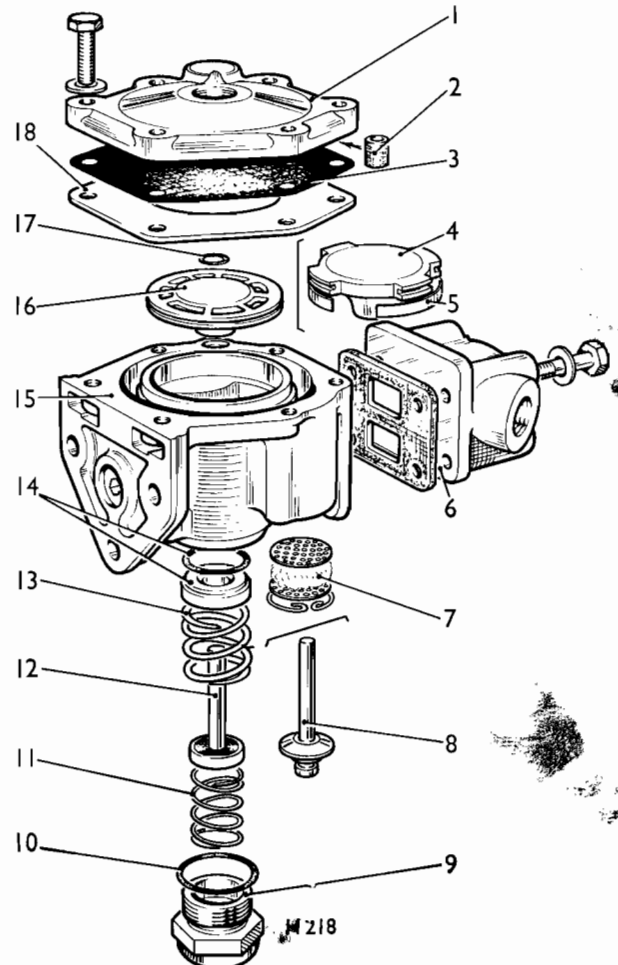


Fig. K26 Relay valve

When the air supply above the diaphragm is reduced by operation of the hand control, the brake chamber pressure lifts the diaphragm and vents the brake air pressure to atmosphere until a lower pressure balance is obtained. Release of the hand control valve lever to the "OFF" position exhausts all air pressure from the brake chambers.

#### To Dismantle

Drain the air pressure system (See Part A).

Remove the unit from its mounting and plug the ends of the pipes to prevent the ingress of foreign matter.

Remove the cover from the relay valve and detach the diaphragm ring, diaphragm, rubber "O" ring and, on **Westinghouse** valves, the distance piece from the bleeder cavity in the cover.

Carefully withdraw the diaphragm guide and on **Clayton Dewandre** valves, also the guide ring.

Unscrew the cap nut and remove the return spring, valve and valve seat retaining spring. The valve seat should not be removed unless it requires renewing; if necessary, press the seat out through the bottom of the body.

Remove the pipe adaptor and joint from the valve body.

#### To Assemble

Thoroughly clean all metal parts in cleaning solvent, examine and renew any part that is worn or damaged, then reverse the procedure for dismantling noting the following:—

It is important that the diaphragm and all rubber "O" rings are **renewed**.

If it is necessary to fit a new valve seat, insert the rubber "O" ring into the valve body before pressing in the seat.

Check the springs for corrosion and distortion.

Assemble the supply valve and springs into the valve body and refit the cap nut with the rubber "O" ring; tighten the cap nut securely.

On **Clayton Dewandre** valves, fit the ring on the guide so that the gap in the ring is centred on one of the four grooved lugs. Check that the guide ring is twisted with one end approximately  $\frac{3}{8}$  in. (9.5 mm.) higher than the other, then smear the ring and supply valve stem with a darium based grease and insert the assembly into the body of the valve.

Fit the rubber "O" ring above the bleeder passage on the body and position the diaphragm ring and diaphragm so that the bleeder passage openings are both in alignment. If a new diaphragm ring is to be fitted, see that both sides of the ring are smooth and the inside diameter is free from sharp edges.

On **Westinghouse** valves, fit the distance piece into the bleeder cavity in the cover.

Finally, fit the cover on the body in its original position and fit a new joint between the adaptor and valve body.

#### To Test

With the air pressure system fully charged, test the operation of the relay valve by applying the brakes. Braking on the wheels should be prompt in action. Release the brakes to check that the air pressure is exhausted promptly from the exhaust port.

Test the exhaust port with a solution of soap and water with the brakes released and similarly with the brakes applied. In either condition it is permissible for a one inch soap bubble to form in one second, but excessive leakage will indicate that either the diaphragm is leaking or that the valve seat should be cleaned or renewed.

The following additional test should be made when a new or overhauled valve has been fitted.

Connect up two accurate air pressure test gauges each side of the relay valve, one in the delivery pipe line from the auxiliary brake hand control valve and the other in the pipe line between the relay valve and brake chambers.

Operate the auxiliary brake hand control valve and check that the relay valve promptly delivers the same pressure, within 3 lb. per sq. in. (0.21 Kg. per sq. cm.), to each brake chamber.

## Section 15

## LOW PRESSURE INDICATOR SWITCH

(See Fig. K27)

#### Method of Operation

Air operated low pressure indicator switches are fitted in the foot and hand brake pipe lines to give the driver ample warning that the air pressure in the reservoirs is insufficient and it is dangerous to proceed. On **tractor** vehicles, an additional warning indicator is provided in the hand controlled auxiliary brake line.

The indicators are connected electrically with an audible buzzer which is located in the driver's cab. **If the buzzer is activated, it must be assumed that pressure in either the main brake or ancillary brake system has fallen below its safe minimum value and the vehicle must be stopped AT ONCE and the cause investigated and rectified.**

When the air system is fully charged, compressed air enters the inlet port and moves the diaphragm and piston against the spring thus opening the contacts. If a drop in reservoir pressure occurs below the spring setting, the spring returns the piston and diaphragm and closes the electrical contacts. This completes the circuit to the buzzer and warns the driver of impending loss of pressure.

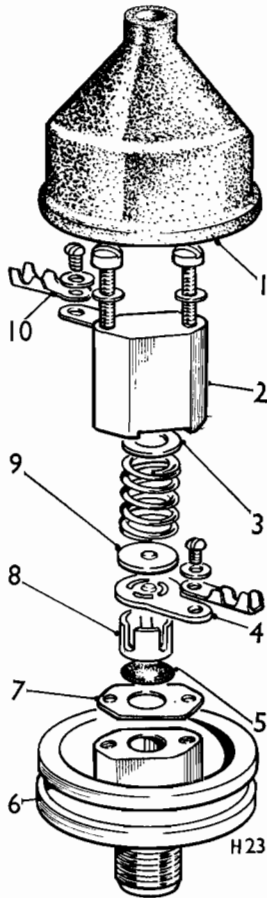


Fig. K27 Low pressure indicator switch

### To Dismantle and Assemble

At vehicle overhaul periods, disconnect the leads to the switch and remove the switch from the pipe line.

Remove the cover, contact disc, spring and shims. Remove the contact plate and rubber diaphragm from the body.

Clean all metal parts in cleaning solvent.

Inspect the contact points for signs of pitting or wear. If the pitting is not too severe the contacts may be reconditioned by means of a fine file; otherwise a new contact disc and plate is necessary. Alternatively, the life of the contacts can be extended by turning the disc and plate over, thus bringing unworn contact surfaces into operation.

If the body or cover is cracked or damaged, renew.

On assembly, smear both the bore in the cover and the cavity in the body with a barium based grease.

Fit a new joint and diaphragm. Insert the piston into the cavity in the body and fit the contact plate over the projections on the piston.

Fit the shims and spring into the cover and position the contact disc over the spring. If no new parts are necessary, the original shims must be used.

Assemble the body to the cover and secure with the two setscrews.

### To Test

The low pressure warning indicators should be tested occasionally by reducing the pressure in each reservoir and then fully charging the reservoir to ascertain that the contact points open and close between the correct pressures (*see Section 25*). Should the switch fail to operate within these limits, dismantle and either subtract or add shims as necessary, and check again.

### Key to Numbers:—

- |                           |                 |
|---------------------------|-----------------|
| 1. RUBBER GAITER          | 6. BODY         |
| 2. INSULATED COVER        | 7. JOINT        |
| 3. SHIM                   | 8. PISTON       |
| 4. CONTACT PLATE ASSEMBLY | 9. CONTACT DISC |
| 5. RUBBER DIAPHRAGM       | 10. TERMINAL    |

## Section 16

## STOP LIGHT SWITCH

(See Fig. K28)

### Method of Operation

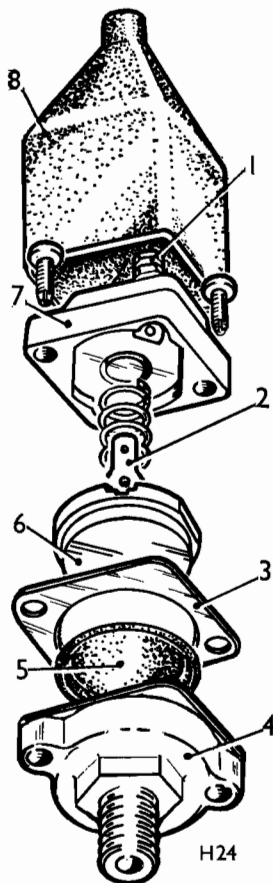
Connected in series with the lamps, the stop light switch comprises a body and cover. It is air operated by means of a rubber diaphragm secured by the cover.

Inside the switch above the diaphragm is a piston, an electrical contact strip on top of the piston, and a piston return spring. The cover has two terminals for connecting to the vehicle electrical system.

When the brakes are applied, compressed air enters the inlet port, moving the diaphragm and piston against spring pressure and thus closing the contact strip against the terminals and completing the circuit. Release of the brakes exhausts the compressed air; the spring returns the diaphragm and piston back to their normal positions and the stop light circuit is broken.

### To Overhaul

At vehicle overhaul periods, disconnect the leads to the switch and remove the switch from the pipe line.



Separate the cover from the body and remove the spring, piston, contact strip and paper joint. Remove the rubber diaphragm from the body.

Wipe the rubber parts with a clean cloth and clean all other parts in cleaning solvent.

If the diaphragm is cracked, worn or damaged, fit a new one.

Inspect the contacts for pitting or wear. If the pitting is not severe, the contact points may be reconditioned by means of a fine file; otherwise fit a new contact strip.

Inspect the spring; if it has lost tension, fit a new one.

The body and cover must be renewed if cracked or damaged.

### To Test

When the switch is refitted on the vehicle, charge the air pressure system and test the switch by applying the foot brake and the hand controlled auxiliary brake. The stop lamp should light up with the first movement of the pedal and hand lever and should be extinguished immediately the pedal or hand lever returns to the release position.

#### Key to Numbers:—

- |                  |                     |
|------------------|---------------------|
| 1. TERMINAL      | 5. RUBBER DIAPHRAGM |
| 2. CONTACT STRIP | 6. PISTON           |
| 3. JOINT         | 7. COVER            |
| 4. BODY          | 8. RUBBER GAITER    |

Fig. K28 Stop light switch

## Section 17

## CONDENSING UNIT (WHEN FITTED)

### Method of Operation

Mounted in the air pressure pipe line between the compressor and the unloader valve, the function of the condensing unit is to extract the majority of moisture from the air so that the compressed air is virtually dry, before entering the remainder of the air pressure system, thus protecting components from failure due to corrosion or freezing.

A renewable filter element is contained within the unit which extracts any foreign matter present in the air; should the filter become clogged it will be automatically by-passed.

An automatic drain valve is fitted in the base of the assembly and is actuated by the operation of the unloader valve, or on certain chassis the brake valve, ensuring consistent drainage of condensate.

### To Overhaul

When the unit is actuated by the brake valve, drain the air pressure from the system (*see Part A*).

Disconnect the air pipes and plug the pipe ends to prevent the ingress of foreign matter.

Remove the unit from its mounting.

Mark the relationship between the condensing cylinder and drain valve assembly and separate them; care should be exercised as the assembly is under spring pressure.

Withdraw the spring, filter retainer and element from the condensing unit.

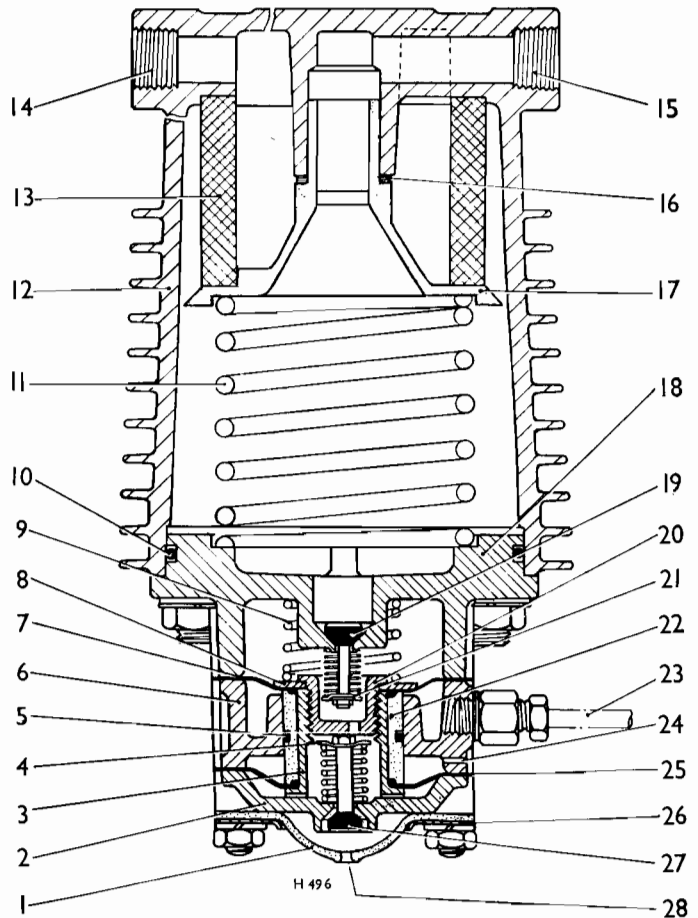
Mark the relationship between the condensing unit base plate, the drain valve body and the bottom cover; remove the drain valve assembly; care should be exercised as the piston is under spring pressure.

Remove the upper and lower valves from the condensing unit base plate and the bottom cover, retaining the springs and spring retainers.

Unscrew the valve centre guide from the diaphragm retainer and remove the diaphragm plate, diaphragms and piston from the drain valve body.

**Key to Numbers:—**

1. DRAIN CAP
2. BOTTOM COVER
3. DIAPHRAGM RETAINER
4. LOWER VALVE SPRING AND RETAINER
5. "O" RING
6. DRAIN VALVE BODY
7. UPPER DIAPHRAGM
8. DIAPHRAGM PLATE
9. PISTON RETURN SPRING
10. "O" RING
11. FILTER RETAINER SPRING
12. CONDENSING CYLINDER
13. FILTER ELEMENT
14. INLET PORT
15. OUTLET PORT
16. "O" RING
17. FILTER RETAINER
18. BASE PLATE
19. UPPER VALVE
20. VALVE CENTRE GUIDE
21. UPPER VALVE SPRING AND RETAINER
22. PISTON
23. DRAIN VALVE OPERATING AIR PIPE
24. VENT HOLE
25. LOWER DIAPHRAGM
26. DRAIN CAP RETAINER
27. LOWER VALVE
28. DRAIN PORT

**Fig. K29 Condensing unit and drain valve assembly**

Examine all parts for wear, paying particular attention to the diaphragms, valves and springs and renew where necessary.

Fit **new** "O" rings to the piston, condensing unit base and filter retainer.

Check that the vent hole in the drain valve body is clear; lightly smear the piston with a barium based grease and assemble it to the body. The valve centre guide and diaphragm plate must be fitted to the side of the body with the bossed interior; do not overtighten the guide and diaphragm retainer. Ensure that the condensate drain port in the piston assembly is clear.

Ensure that the **lower** valve with the **longer** stem and the **stronger** spring is fitted to the bottom cover.

Fit a **new** filter element to the condensing unit.

Align all marks made on dismantling and tighten the drain valve nuts evenly and in sequence to the specified torque loading of 5 lb. ft. (0.7 Kg.M.).

When assembling the drain valve assembly to the condensing cylinder tighten the nuts to the specified torque loading of 16.7 lb. ft. (2.3 Kg.M.).

**To Test**

Charge the air system to just below the unloader valve cut-out pressure (*see Section 25*).

Coat the entire condensing and drain valve unit with a solution of soap and water; leakage from the drain port in excess of **a quarter-inch soap bubble in five seconds** is not permissible. Leakage from any other part of the unit is not permissible.

Charge the air system to the normal maximum operating pressure. (*See Section 25*).

Coat the drain valve body, drain port and the operating air pipe connection with a solution of soap and water; air leakage is not permissible.

## Section 18

### FOOT BRAKES

(Lockheed Type)

(See Fig. K30)

#### To Adjust

##### Foot Brake

Jack up the axle or each wheel in turn, releasing the hand brake to the fully "off" position and chocking the **front** wheels in front and behind when adjusting the rear brakes.

Turn the square ended adjusting stem in a **clockwise** direction, until the brake shoe linings contact the drum, then unscrew the stem until the road wheel rotates freely with the brake linings just clear of the brake drum.

**If replacement shoes have been fitted, the brake shoes relined or the drums skimmed**, the following procedure should be adopted for centralising each brake shoe.

Remove the bolts securing the adjuster stem bracket to the torque plate and detach the brake adjuster stem assembly.

Insert a suitable lever or screw driver through the aperture in the backplate to engage the exposed splines of the adjuster nut serving the lower leading shoe. Turn the adjuster nut with a screwdriver, until the brake lining contacts the drum and prevents the road wheel being rotated in a forward direction. Repeat the same sequence for the adjuster nut serving the upper trailing shoe.

Re-adjust the **upper** shoe to give a **minimum** clearance and the **lower** shoe to give a clearance of 0.015 in. (0.38 mm), between the respective shoe and brake drum. This will ensure, when the wheels are lowered

to the ground, a **uniform** clearance for both upper and lower shoes.

Refit the adjuster stem assembly, making sure that the crown wheel mates with the splines of the **adjuster** nut and that the mounting bracket securing bolts are tightened down evenly in succession.

Finally, check the clearance between the brake shoe linings and drums by means of the **adjusting stem**, as previously described.

For:—

**Parking Brake**, see Section 1.

**Uneven Braking**, see Section 2.

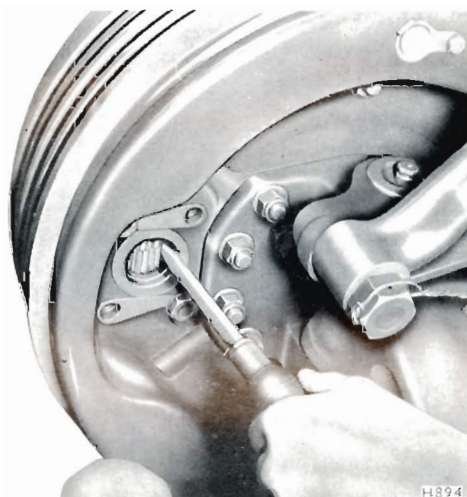


Fig. K30 Method of turning the adjuster nuts for centralising of brake shoes

## Section 19

### BRAKE SHOES

(Lockheed type)

(See Figs. K31 and K32)

#### To Remove

Jack up the axle and remove the road wheel and brake drum (see *Parts G and H*).

Support the assembly by placing a jack under the lower brake shoe. Retain the lower adjuster screw and nut in position by means of a suitable clip or length of wire.

Holding the hexagon head of the spring anchor pivot pin, turn the spring anchor pivot pin, nearest the adjuster unit in a **anti-clockwise** direction, and unhook the connecting rod. By turning the opposing anchor pivot pin in a **clockwise** direction release the other connecting rod. Similarly, on **rear axle** brake shoes, turn both anchor pins together in a **clockwise** direction to extend the springs and unhook the connecting rods.

#### To Recondition

Replacement linings are supplied drilled and the holes counterbored for the rivets.

When riveting on new linings, make sure that the rivet heads are well down beneath the surface of the lining and that a good "snap" head is formed.

After riveting, plug the recesses with cork plugs and remove all burrs with a file.

If facilities are not available for grinding the linings, so that their outside diameter suits the inside diameter of the brake drum, the vehicle should be given an initial run to allow the brake shoe linings to bed themselves in the brake drum.

**To Fit**

Thoroughly clean all parts and lightly grease all moving parts with a good quality lithium base grease, ensuring not to get grease on the brake shoe linings.

Pair the shoes so that they are positioned as shown in Figures K31 and K32. Identification is stamped on the web of the shoe e.g., either "Trailing" or "Leading", which occupies the upper or lower positions when assembled.

Examine the push rods, spring anchors and pins for signs of wear and renew where necessary. On assembly, all pins should be fitted with **new** circlips.

Fit the spring anchors and pins to the shoes, noting that on **rear axle** shoes, the anchors are centralised between the webs of the shoe by a bush fitted to the pivot pin. The spring anchors fitted to the wrist pins are centralised when connected to the pull-off spring. Check that all pivot pin washers are fitted in the correct sequence.

The adjuster screws are provided with left-hand threads; fit the fibre washer on the screws and screw them into the adjuster nuts leaving the abutment slots exposed and clear of the nuts. Insert an assembled screw and adjuster nut into the upper portion of the adjuster body but with the abutment slot parallel to

the torque plate. The other screw and adjuster nut need not be fitted until the lower shoe is offered up.

Slide the shoes into position ensuring that the push rods are properly seated in the cam head and that the heel of each web engages each adjuster screw. The shoes may be held together using a suitable length of wire.

**On front axle shoes**, hook the connecting rods into the web of the upper shoe and turn the right-hand spring anchor **anti-clockwise** to engage each connecting rod.

**On rear axle shoes**, hook the connecting rods on the spring anchors of the trailing shoe with their hooks facing towards the torque plate. Turn the pivot pins on the upper and lower shoes **clockwise** to engage the connecting rods with the lower spring anchors.

When the shoes are fitted, tap them into position with a hide or copper hammer to ensure that they are correctly centralised.

Fit the hubs, if removed (*see Part G or H*).

Ensure that the brake drums are clean and free from grease, then fit (*see Part G or H*).

Adjust the brakes as described in Section 18.

**Section 20****BRAKE DRUMS**

(used with Lockheed brakes)

**To Remove**

Remove the brake drum as instructed in Part G or H.

**To Recondition**

If necessary, brake drums can be skimmed to obtain a smooth, polished surface, care being taken to remove as little metal as possible.

A **maximum** of  $\frac{1}{4}$  in. (6.4 mm.) on the **diameter** may be removed, i.e., the inside diameter of the brake drum should not, at any time, exceed  $15\frac{3}{4}$  in. (400 mm.)

To compensate for metal removed, see under Section 18, "**To Adjust**".

**Section 21****BRAKE OPERATING SHAFT AND EXPANDER UNIT**

(Lockheed types)

(*See Figs. K31 and K32*)

**To Dismantle**

Remove the brake shoes (*see Section 19*).

Remove the fork end pin from the brake operating lever and remove the clamping bolts and lever. Remove the felt washer from the rear axle brake operating shaft.

**Front Axle Brake Assembly**

Remove the lubricator from the expander housing.

To remove the operating shaft from the brake assembly, unscrew the lock nuts securing the strap to the steady posts and remove the spring and strap. Withdraw the shaft from the bearing housing.

Remove the bolts from each end of the bearing housing and detach the housing from the torque plate.

Remove the seal retainer, grease seals and bearing bushes.

**Rear Axle Brake Assembly**

Disconnect the lubrication pipe (if fitted) from the operating shaft bearing bracket to the axle casing and slide the bracket, cover tube and bush from the end of the shaft.

Remove the locknuts from the bearing housing, detach the bolts, strap, spring, steady posts and, on the rear axle, the steady plates. The operating shaft can then be withdrawn from the housing and the housing detached from the torque plate. Remove the seal retainer and grease seal and remove the bearing support and spherical bearing.

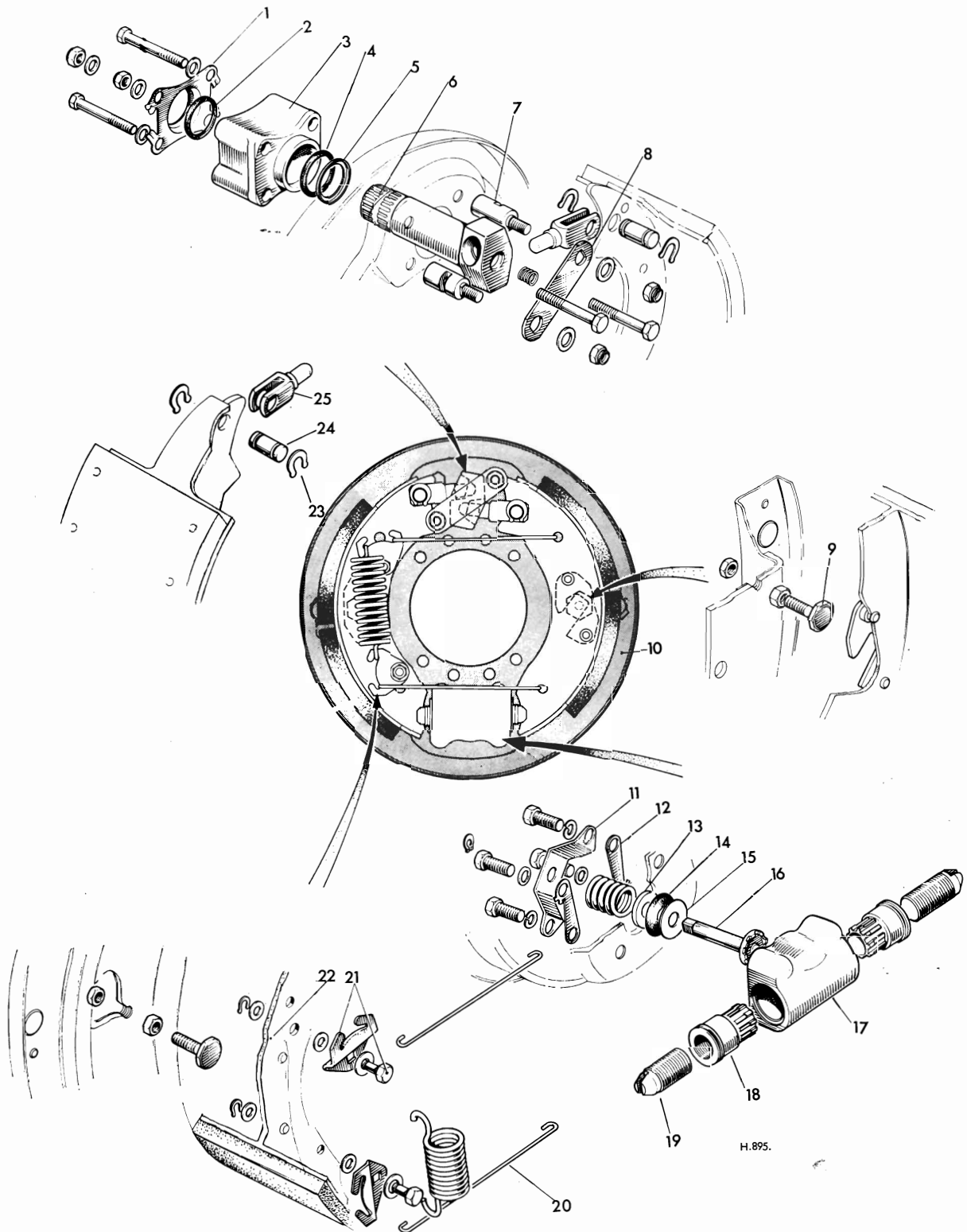


Fig. K31 Front axle brake assembly

**To Assemble**

Wash all parts in clean paraffin and examine for signs of wear. Renew parts where necessary and assemble by reversing the sequence for dismantling noting the following:—

Should it be necessary to renew the bearing bushes on the **front axle brake assembly**, press them in flush

with the inner recesses of the housing. **On the rear axle brake assembly**, press the bushes in flush with the outer ends of the spherical bearing.

Fit the seal retainer on the shaft against the cam and smear the shaft with grease prior to assembly. Fit both seals with their lips facing **towards** the lever end of the shaft.

**Section 22****BRAKE ADJUSTER UNIT**

(Lockheed type)

(See Figs. K31 and K32)

**To Dismantle**

Unscrew the setscrews retaining the bracket and remove the adjuster unit from the torque plate.

Remove the circlip from the adjuster stem and detach the bracket, spring, retainer, seal and plate.

Remove the brake shoes (see Section 19) and remove the adjuster screws and nuts from the housing.

Unscrew the setscrews securing the adjuster housing to the torque plate and lift off the housing.

**To Assemble**

Wash the parts in clean paraffin. Examine the

crown wheel on the adjuster stem for wear and renew if necessary.

On assembly, liberally coat the **adjuster nuts and screws** with a good quality lithium base grease and then assemble in the reverse order to dismantling noting that the seal should be fitted with the lip facing towards the spring and retainer.

After assembly, compress the spring slightly in order to fit the circlip; the exact position for this on the adjuster stem is not important.

Fit the adjuster unit on the torque plate and tighten the setscrews in logical sequence to compress the spring evenly.

**Section 23****LOAD SENSING VALVE AND LINKAGE ASSEMBLY**

(See Figs. K33, K34 and K35)

**Introduction**

The load sensing valve is mounted on the vehicle chassis adjacent to the rear axle and is connected to the axle by a linkage assembly. A shock absorber and knuckle joint are incorporated in the linkage to reduce movements caused by rough road surfaces.

The purpose of the valve is to deliver compressed air to the brake chambers at a pressure determined by the load carried by the vehicle, and which is proportional to the effort being applied to the brake pedal by the driver.

**Method of Operation**

When the brake pedal is depressed, air from the brake valve causes the control piston to open the inlet

valve and admit air to the brake chambers. As air acting on the balance piston causes the beam to pivot, the control valve piston rises and closes the inlet valve so that the unit is held in a balanced condition. Release of the brake pedal allows all air from the brake chambers to be exhausted to atmosphere.

**To Test****Load Sensing Valve**

To test the operation of the control valve piston and valves, chock the wheels and fully apply the brakes using the foot brake valve and then release the brakes. The load sensing valve should exhaust air through the filter element at the same time as the brakes are released.

**Key to Numbers:—**

BRAKE OPERATING SHAFT AND EXPANDER UNIT	1. COVER
	2. SEAL
	3. BEARING HOUSING ASSEMBLY (includes bushes)
	4. SEAL
	5. SEAL RETAINER
	6. OPERATING SHAFT
	7. STEADY POST
	8. STEADY STRAP
BRAKE ADJUSTER UNIT	9. STEADY BOLT
	10. TORQUE PLATE
	11. BRACKET
	12. LOCKING PLATE

BRAKE ADJUSTER UNIT	13. SPRING RETAINER
	14. SEAL
	15. PLATE
	16. ADJUSTER STEM
	17. ADJUSTER UNIT HOUSING
	18. ADJUSTER NUT
	19. ADJUSTER SCREW
	20. CONNECTING ROD
BRAKE SHOE ASSEMBLY	21. SPRING ANCHOR AND PIVOT PIN
	22. BRAKE SHOE
	23. CIRCLIP
	24. WRIST PIN
	25. PUSH ROD

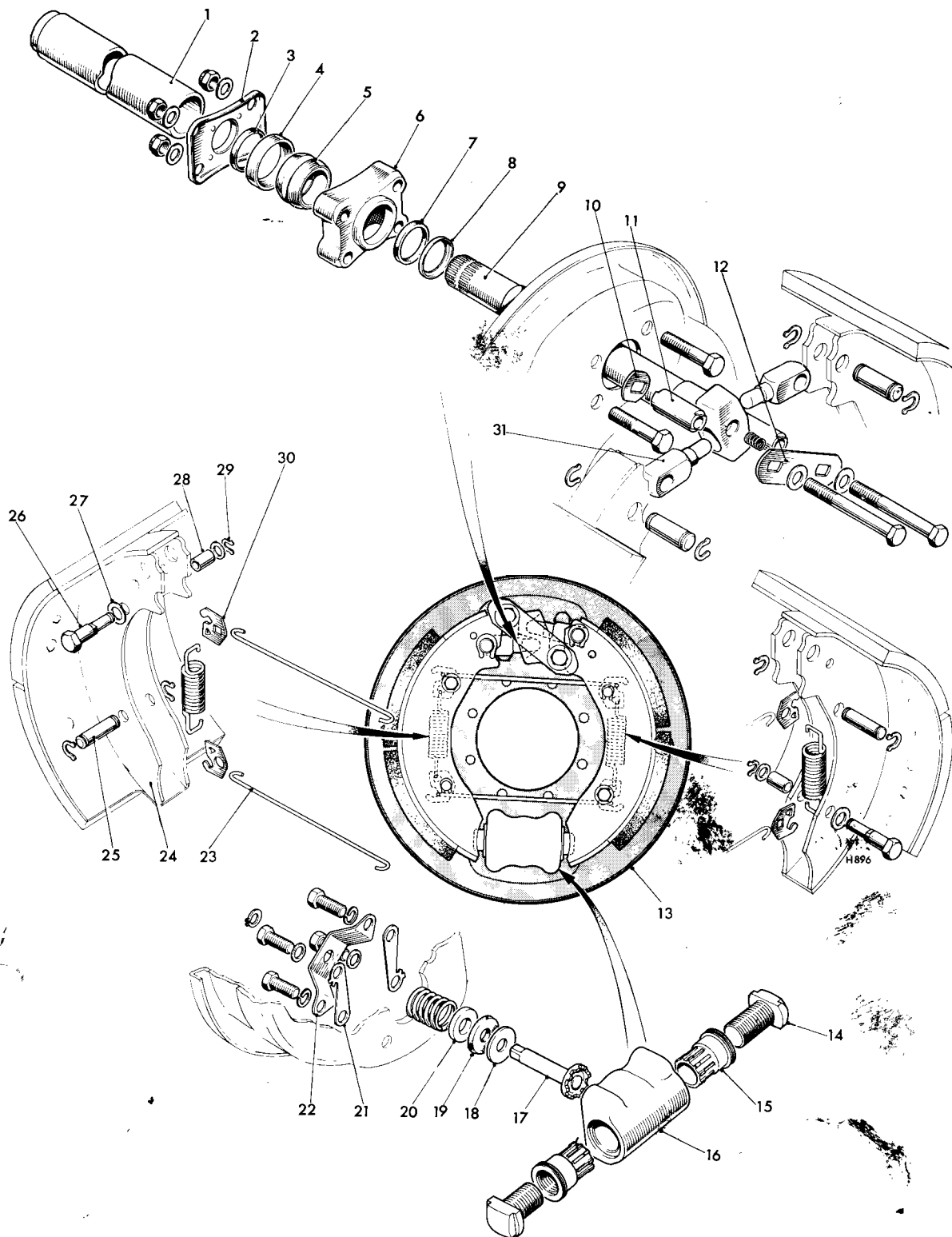
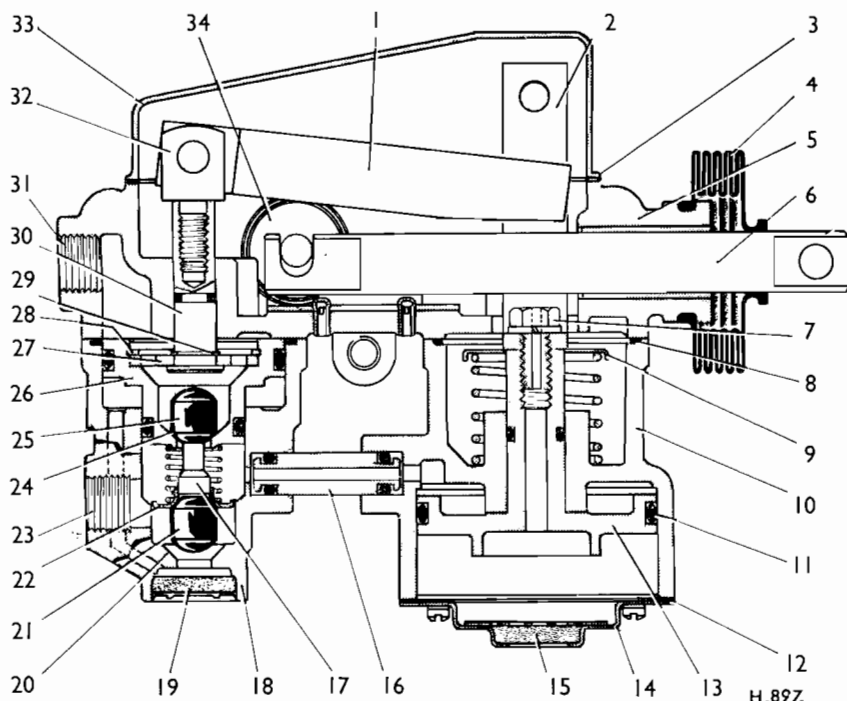


Fig. K32 Rear axle brake assembly



## Key to Numbers:—

1. BALANCE BEAM
2. CONNECTING FORK
3. JOINT
4. GAITER
5. HOUSING ASSEMBLY
6. CONTROL ROD
7. SETSCREW
8. SEALING RING
9. SPRING RETAINER
10. HOUSING
11. SEALING RING
12. JOINT
13. BALANCE PISTON
14. COVER ASSEMBLY
15. FILTER ELEMENT
16. TRANSFER TUBE
17. STEM
18. CONTROL VALVE BODY
19. FILTER ELEMENT
20. EXHAUST VALVE SEAT
21. EXHAUST VALVE
22. VALVE GUIDE
23. TO BRAKE CHAMBERS
24. INLET VALVE SEAT
25. INLET VALVE
26. CONTROL VALVE PISTON
27. CONNECTING ROD RETAINER
28. CIRCLIP
29. CIRCLIP
30. CONNECTING ROD
31. TO BRAKE VALVE
32. CONNECTING ROD END
33. TOP COVER
34. ROLLERS

Fig. K33 Load sensing valve

If the control valve operates satisfactorily, an additional test may be carried out, when the vehicle is fully or partially laden, to check the operation of the balance piston and beam.

Using the foot brake valve, fully apply the brakes and maintain the application.

Without disconnecting the linkage, push the control rod towards the load sensing valve against the resistance of the shock absorber and knuckle joint; the valve should release air through the filter element in the control valve body if operating correctly.

## Linkage Assembly

The following test may be carried out to check the operation of the shock absorber and knuckle joint.

Chock the wheels and without disconnecting the linkage, move the shock absorber lever in both directions through its stroke by manual movement on the lever. If the lever can be moved quickly without strong resistance, in either or both directions, the shock absorber is **not** functioning correctly.

Move the lever to one end of its stroke and then release. Check that the knuckle joint slowly returns the lever to its original position. If the lever fails to return, the knuckle joint is defective.

## To Test for Air Leakage—Load Sensing Valve

The following test should preferably be carried out with the vehicle **fully laden**, but if this is not practicable, loading on the valve may be simulated by withdrawing the control rod to its fullest extent without disconnecting the linkage.

Charge the air pressure system and then fully apply the foot brake and maintain the application.

Apply a solution of soap and water to the valve unit; air leakage may then be detected by the appearance of bubbles. If leakage occurs in excess of a half-inch soap bubble in five seconds from either one or both of the filter elements, the sealing rings on the pistons or the connecting rod are defective and should be renewed. Air leakage from any other part of the unit during this test is not permissible.

## Key to Numbers:—

- |   |   |                             |
|---|---|-----------------------------|
| BRAKE OPERATING<br>SHAFT AND EXPANDER<br>UNIT | { | 1. COVER TUBE               |
|   |   | 2. COVER                    |
|   |   | 3. SEAL                     |
|   |   | 4. BEARING SUPPORT          |
|   |   | 5. BEARING HOUSING ASSEMBLY |
|   |   | 6. BEARING HOUSING          |
|   |   | 7. SEAL                     |
|   |   | 8. SEAL RETAINER            |
|   |   | 9. BRAKE OPERATING SHAFT    |
|   |   | 10. STEADY PLATE            |
|   |   | 11. STEADY POST             |
|   |   | 12. STEADY STRAP            |
| BRAKE ADJUSTER<br>UNIT                        | { | 13. TORQUE PLATE            |
|   |   | 14. ADJUSTER UNIT           |
|   |   | 15. ADJUSTER NUTS           |

- |                        |   |                           |
|------------------------|---|---------------------------|
| RAKE ADJUSTER<br>UNIT  | { | 16. ADJUSTER UNIT HOUSING |
|                        |   | 17. ADJUSTER STEM         |
|                        |   | 18. PLATE                 |
|                        |   | 19. SEAL                  |
|                        |   | 20. SPRING RETAINER       |
|                        |   | 21. LOCKING PLATE         |
|                        |   | 22. BRACKET               |
| BRAKE SHOE<br>ASSEMBLY | { | 23. CONNECTING ROD        |
|                        |   | 24. BRAKE SHOE            |
|                        |   | 25. WRIST PIN             |
|                        |   | 26. PIVOT PIN             |
|                        |   | 27. WASHER                |
|                        |   | 28. BUSH                  |
|                        |   | 29. CIRCLIP               |
|                        |   | 30. SPRING ANCHOR         |
|                        |   | 31. PUSH ROD              |

To test the valve in an unladen condition, push the control rod towards the load sensing valve and hold the rod against its stop without disconnecting the linkage; fully apply the foot brake and apply a soap and water solution to the filter element.

If in the previous test there was no leakage from the control valve sealing rings or exhaust valve, leakage in excess of a half inch soap bubble from the filter element will indicate that the inlet valve is leaking and must be renewed.

### To Dismantle

#### Load Sensing Valve

Drain the air pressure system (*see Part A*).

Without disturbing the setting of the linkage assembly, disconnect the pull-rod from the control rod and remove the unit from its mounting; plug the ends of the pipes to prevent the ingress of foreign matter.

Clean the exterior of the valve and remove the top cover and joint.

Release the retainers from the rod and fork pins and remove the pins and balance beam.

Detach the rubber gaiter from the mounting box, lift out the roller assembly and withdraw the control rod from the box.

Unscrew the connecting rod end from the rod.

Remove the securing nuts and separate the control valve and balance piston housings from the mounting box. Detach the transfer tube from the housings when clear of the box; remove the rubber "O" rings.

Withdraw the piston from the control valve housing and remove the circlip from the connecting rod. Using the rod to hold the inlet valve against its seat, depress the valve guide and spring and remove the rubber exhaust valve.

Detach the rubber "O" rings from the piston. Remove the circlip and connecting rod from the piston and withdraw the rod from the retainer.

Remove the valve stem from the piston and pull off the rubber inlet valve from the stem.

Remove the balance piston cover assembly and joint.

Using the hexagonal part of the balance piston to prevent the piston from turning, unscrew the setscrew and remove the spring washer, connecting fork, spring retainer and spring. Withdraw the piston from the housing and remove the rubber "O" rings.

The filter elements need not be removed unless unserviceable.

#### Knuckle Joint

Disconnect the clamp bolt from the vertical link and remove the mounting bolts and knuckle joint from its mounting. Clean the exterior of the unit.

Remove the rubber gaiter.

Rest the knuckle housing upright on a flat surface, push the rod against the compression of the spring and remove the circlip. Withdraw the knuckle pivot housing, pivot and rod assembly and spring.

### To Assemble

#### Load Sensing Valve

Thoroughly clean all metal parts in clean paraffin, examine and renew any part that is worn or damaged, then reverse the procedure for dismantling noting the following.

Check all rubber parts for wear, damage or deterioration and renew if necessary. It is important that all rubber "O" rings are **renewed**.

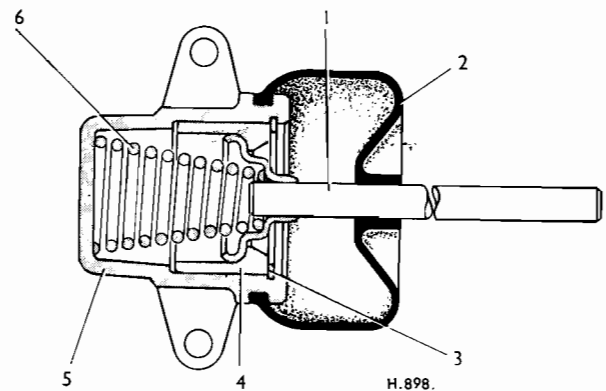
Examine the pistons for cracks or other damage, and check the sliding surfaces of the pistons and the corresponding bores in the housing for excessive wear or scores.

If a new filter element is to be fitted in the control valve housing, a **new** self-locking retainer must be fitted.

Should the inlet and exhaust valve rubbers require renewing, fit the inlet valve first; a smear of soap solution on the stem will assist fitting. Place the stem, with the inlet valve installed in the control valve piston and assemble the connecting rod, retainer and circlip in the piston. Using the connecting rod to hold the inlet valve against its seat, depress the guide and spring in order to press the exhaust valve on the stem. Afterwards, lift the connecting rod and locate with a **new** circlip.

Lightly smear the rubber "O" rings, and piston assemblies with a barium based grease. The pins and bearing surfaces of the connecting rod end, balance beam, roller, control rod, and fork should be more liberally greased.

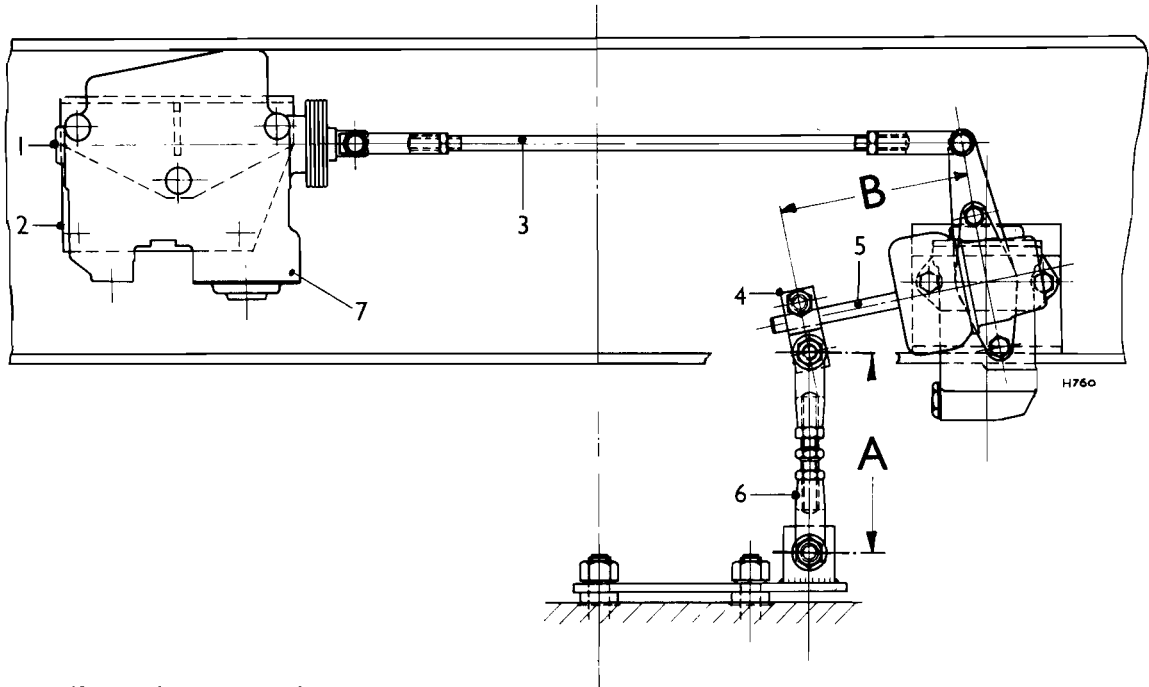
Finally; the parts of the roller assembly should be assembled on the pin in the following order; retainer, large roller, washer, two small rollers, washer, large roller and retainer.



#### Key to Numbers:—

1. KNUCKLE PIVOT AND ROD ASSEMBLY
2. GAITER
3. CIRCLIP
4. KNUCKLE PIVOT HOUSING
5. KNUCKLE HOUSING
6. SPRING

Fig. K34 Knuckle joint



#### Keys to Letters and Numbers:—

EARLY VEHICLES	A. $5\frac{1}{2}$ in. (146 mm.)	} TG4R
	B. $5\frac{1}{8}$ in. (136.5 mm.)	
	A. $8\frac{1}{2}$ in. (216 mm.)	} TGM4R
	B. 5 in. (127 mm.)	
LATE VEHICLES	A. $5\frac{1}{2}$ in. (146 mm.)	} TG4R
	B. $8\frac{1}{2}$ in. (222 mm.)	
	A. $6\frac{1}{8}$ in. (168 mm.)	} TGM4R
	B. $8\frac{1}{2}$ in. (222 mm.)	
	A. } Supplied on	} TGM6R and
	B. } Application	
		TG6R

1. AIR INLET FROM BRAKE VALVE
2. AIR OUTLET TO BRAKE CHAMBERS
3. PULL-ROD
4. CLAMP—KNUCKLE ROD
5. KNUCKLE ROD
6. VERTICAL LINK
7. LOAD SENSING VALVE

Fig. K35 Setting instructions for typical linkage

Renew the paper joints between the covers and the valve body.

When the valve has been assembled, refit and connect up the linkage (*see under "To Test" and "Setting Instructions"*).

#### Knuckle Joint

Wash all metal parts in clean paraffin, examine and renew any part that is worn or damaged. Reverse the procedure for dismantling noting the following.

When re-connecting the linkage with the lever, ensure that the clamp is correctly positioned on the rod (*see "Setting Instructions"*).

#### Setting Instructions

##### Linkage Assembly

**Note:—It is important that the linkage settings "A" and "B" shown in Fig. K35 are not altered.**

If the linkage settings have been disturbed, adjust the linkage whilst the vehicle is **unladen** as follows:—

Drain the air pressure system (*see Part A*).

Disconnect the air pipe from the delivery side of the load sensing valve and insert a pressure gauge in the

line, reading up to at least 150 lb. per sq. in. (10.5 kg. per sq. cm.).

Disconnect the vertical link at its axle end and adjust the length to dimension "A" as required (*see Fig. K35*).

Adjust the clamp on the knuckle arm to dimension "B" as required (*see Fig. K35*) and tighten the locknuts.

Fully charge the air pressure system.

Disconnect the pull-rod at the valve end and withdraw the control rod from the valve until it is fully extended.

Check the air pressure on the gauge is at least 100 to 110 lb. per sq. in. (7.03 to 7.7 kg. per sq. cm.).

Push the control rod in  $1\frac{9}{16}$  in. (39.7 mm.) and lock the valve in this position by applying the foot brake.

Adjust the pull-rod fork end to line up with the valve and insert the clevis pin; tighten the locknuts.

Again check the air pressure on the delivery side of the valve, which should deliver air at the correct operating pressure given in Section 25.

Drain the air pressure system.

Remove the test gauge and reconnect the air pipe to the valve.

Charge the air pressure system.

## Section 24

## QUICK RELEASE VALVE

(See Fig. K36)

**Introduction**

The purpose of the quick release valve is to reduce the time required to release the brakes by hastening the exhaust of air pressure from the brake chambers.

**Method of Operation**

When the brakes are applied, compressed air overcomes the spring loaded diaphragm and passes air to the brake chambers.

As soon as air pressure in the brake chambers is equal to the pressure delivered by the brake valve, the diaphragm closes both the inlet and exhaust ports and a balanced pressure is held each side of the diaphragm.

Release of the brakes, enables the spring loaded diaphragm to lift and permit brake chamber air pressure to escape through the valve exhaust port.

**To Dismantle**

Release the air from the brake system (*see Part A*).

Remove the unit from its mounting and plug the pipes to prevent the ingress of foreign matter.

Unscrew the cover from the valve body and remove the spring, spring seat and rubber diaphragm.

**To Assemble**

Thoroughly clean all metal parts in cleaning solvent and allow to dry. The rubber diaphragm should be wiped with a clean cloth.

Reverse the procedure for dismantling noting the following:—

Examine the rubber diaphragm for signs of deterioration or wear; if the diaphragm is pitted or grooved on its exhaust side it must be renewed.

Check the spring seat for wear or damage and renew if necessary. If the spring has lost tension, fit a new one.

Inspect the exhaust seat for scratches or pitting. This can sometimes be resurfaced by carefully lapping the seat using a piece of fine emery cloth on a flat surface. Alternatively, if the scratching or pitting is too deep, a new cover must be fitted.

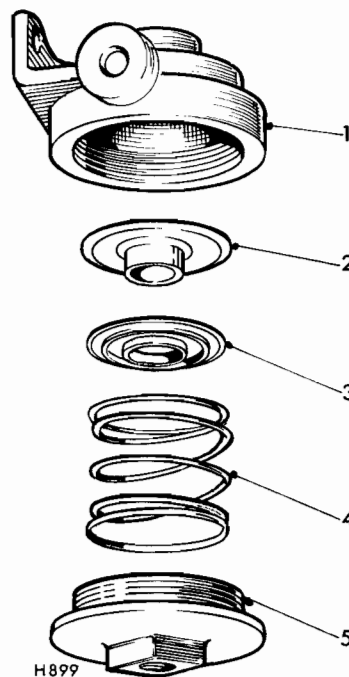
**To Test****Operation**

Charge the air pressure system.

Apply the brakes and note that when the brakes are released, air pressure is quickly exhausted through the exhaust port of the valve.

**Air Leakage**

With the brakes applied, coat the exhaust port with a solution of soap and water. Leakage in excess of a one inch soap bubble in one second is not permissible.

**Key to Numbers:—**

1. BODY
2. RUBBER DIAPHRAGM

**3. SPRING SEAT****4. SPRING****5. COVER**

Fig. K36 Quick release valve

## Section 25

## FAULT FINDING GUIDE AND TEST FIGURES

**Fault Finding Guide**

Symptom	Cause	Remedy
A. Slow pressure build up	1. Drain plug defective	Overhaul ( <i>see Section 8</i> ).
	2. Leakage in pipe line, compressor to reservoir or reservoir to gauge or warning device	Test for leakage and rectify.

Symptom	Cause	Remedy
A.— <i>continued</i>	3. Unloader valve defective ..	Check for escape of air from exhaust. If detected, overhaul unloader, paying particular attention on Westinghouse equipment, to the relay piston. On Clayton Dewandre equipment:— Ball valve type Examine the relay piston and ball valve assembly ( <i>see Section 9</i> ). Diaphragm type Examine the valves or sealing rings of the governor and unloader plungers. Leakage from the vent hole in the top cover indicates a ruptured diaphragm ( <i>see Section 9</i> ). 4. Leaking brake valve .. .. Overhaul ( <i>see Section 10</i> ). 5. Compressor faulty .. .. Overhaul, paying particular attention to valves and springs ( <i>see Part B</i> ).
B. Compressor does not unload at normal operating pressure ..	1. Unloader valve defective ..	Check and correct unloader valve setting or overhaul unloader valve ( <i>see Section 9</i> ).
C. System does not hold pressure	1. Non-return valve in unloader valve defective. Refer also to items A1 to A4. . . . .	Overhaul unloader, paying attention to non-return valve ( <i>see Section 9</i> ).
D. Brake application slow or no brakes .. .. .	1. Brake pipe lines leaking .. 2. Brake pipe lines partially blocked .. .. . 3. Low brake line pressure .. 4. Brake air chambers leak ..	Test for leakage and rectify. Clean or fit new pipes. Adjust brake valve unit ( <i>see Section 10</i> ). Overhaul brake chambers ( <i>see Section 7</i> ).
E. Brake release slow .. ..	1. Brakes incorrectly adjusted .. 2. Combined inlet/exhaust valves not seating properly .. ..	See Section 1. Overhaul brake valve unit ( <i>see Section 10</i> ).
F. Brakes bind .. .. .	1. Incorrectly adjusted .. .. 2. Brake valve defective .. ..	See Section 1. Disconnect pipes to brake chambers and listen for escaping air. Overhaul brake valve ( <i>see Section 10</i> ).
G. Brakes fierce .. .. .	1. Brake pedal adjustment incorrect. See also item F2 ..	Adjust brake valve unit ( <i>see Section 10</i> ).

#### Air pressure settings:—

##### Unloader valve

Clayton Dewandre ..	Cut-out pressure	120±2 lb. per sq. in. (8·4±0·14 Kg. per sq. cm.).
	Cut-in pressure ..	106±2 lb. per sq. in. (7·4±0·14 Kg. per sq. cm.).
Westinghouse ..	Cut-out pressure	120±2·5 lb. per sq. in. (8·4±0·17 Kg. per sq. cm.).
	Cut-in pressure ..	110±2·5 lb. per sq. in. (7·7±0·17 Kg. per sq. cm.).

Brake valve—Graduated setting .. .. . 0—90 lb. per sq. in. (0—6·3 Kg. per sq. cm.).

Maximum line pressure to brake air chambers .. As unloader valve cut-out pressure or as shown on air pressure gauge.

##### Regulating valve—operating pressure for:—

Parking brake .. .. .	75 lb. per sq. in. (5·3 Kg. per sq. cm.).
Differential lock unit (when fitted) ..	60 lb. per sq. in. (4·2 Kg. per sq. cm.).

**Air pressure settings (continued)**

Pressure reducing valve—Operating pressure for:—

1st Driving axle brake air chambers	Clayton Dewandre	40 to 45 lb. per sq. in. (2.8 to 3.16 Kg. per sq. cm.).
	Westinghouse ..	42.5 lb. per sq. in. (2.95 Kg. per sq. cm.).
Parking brake air chambers	Clayton Dewandre	50 to 55 lb. per sq. in. (3.5 to 3.9 Kg. per sq. cm.).
	Westinghouse ..	52.5 lb. per sq. in. (3.7 Kg. per sq. cm.).

Auxiliary brake hand control valve graduated settings:—

Initial pressure .. .. .	5 lb. per sq. in. (0.35 Kg. per sq. cm.).
Maximum pressure .. .. .	75 to 85 lb. per sq. in. (5.27 to 5.9 Kg. per sq. cm.).

Low pressure switch—Operating pressure:—

Clayton Dewandre .. .. .	54 to 66 lb. per sq. in. (3.8 to 4.6 Kg. per sq. cm.).
Westinghouse .. .. .	60 to 65 lb. per sq. in. (4.2 to 4.6 Kg. per sq. cm.).

Stop light switch—Operating pressure .. .. 3 to 7 lb. per sq. in. (0.21 to 0.49 Kg. per sq. cm.).

Load sensing valve—Minimum Operating pressure .. 25 to 28 lb. per sq. in. (1.76 to 2.0 Kg. per sq. cm.).

**Compressor Delivery Test:—**

Approximate time to charge reservoirs to unloader valve cut-out pressure with a compressor delivery output of 13.5 cu. ft. (382 litres) per min. at 1000 r.p.m.

Chassis type	Brake system	APPROXIMATE Total Reservoir capacity	APPROXIMATE time in seconds to charge reservoirs at engine governed speed of:—	
			2,000 r.p.m.	2,200 r.p.m.
Mercury (load carrier) TGM4	Single line	C. 2,500 cu. in. (41.0 litres) W. 2,650 cu. in. (43.4 litres)	To Follow ,, ,,	70
	Dual line	3,300 cu. in. (54.1 litres)	,, ,,	To Follow
Mercury (tractor) TGM4	Dual line	4,000 cu. in. (65.6 litres)	,, ,,	95
Marshal TGM6RS, RT (load carrier)	Single line	3,700 cu. in. (60.2 litres)	,, ,,	85
	Dual line	4,500 cu. in. (73.7 litres)	,, ,,	To Follow
Mandator (load carrier) TG4	Single line	2,600 cu. in. (42.6 litres)	,, ,,	—
	Dual line	3,400 cu. in. (55.7 litres)	,, ,,	—
Mandator (tractor) TG4	Dual line	4,500 cu. in. (73.7 litres)	120	—
Mammoth Major (load carrier) TG6RB TG8RB, RD, RS and RT	Single line	3,700 cu. in. (60.2 litres)	105	—
	Dual line	4,500 cu. in. (73.7 litres)	To Follow	—
Mammoth Major (tractor) TG6RT	Dual line	5,800 cu. in. (95.0 litres)	165	—
Mammoth Minor TG6RF (tractor)				

C = Clayton Dewandre      W = Westinghouse

## Section 5A BRAKE OPERATING SHAFT AND EXPANDER UNIT

(Girling late type)

(See Fig. K37)

### To Dismantle

Remove the brake shoes (see Section 4).

Detach the upper expander tappet head, tappet, rubber "O" ring and strut from the housing; the lower tappet assembly will be detached during the removal of the brake shoes.

Remove the fork-end pin from the brake operating lever and remove the clamping bolt and lever. Remove the felt washer from the rear axle brake operating shaft.

On the rear axle expander unit, disconnect the lubrication pipe (if fitted) from the operating shaft bearing bracket. Remove the nuts securing the bearing bracket to the axle casing and slide the bracket, cover tube and bush from the end of the shaft.

Remove the lubricator from the expander housing.

Remove the expander housing from the torque plate.

Remove the circlip retaining the operating shaft and remove the retaining plate, rubber "O" ring and shaft.

Press out the bush and seal from the housing, noting that on the front axle expander unit the housing is fitted with two bushes.

### To Assemble

Thoroughly clean and examine all parts for signs of wear and renew where necessary.

Reverse the sequence for dismantling noting the following:—

When renewing bushes, note that the bush nearest the cam end should be pressed in just under the recess in the end of the housing. The additional bush fitted to the front axle expander unit should be pressed into the opposite end of the housing and flush with the recess.

Renew all rubber "O" rings and fit a new seal with the lips of the seal facing outwards towards the splined end of the operating shaft.

Ensure that the felt washer on the rear axle brake operating shaft is fitted before assembling the brake lever.

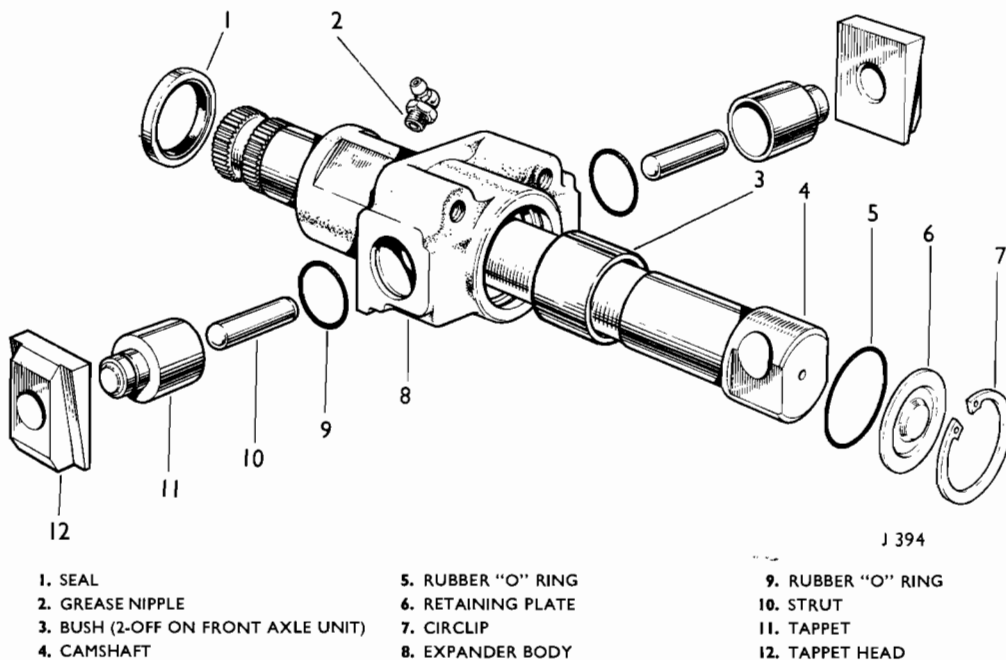


Fig. K37 Brake operating shaft and expander unit—Girling late type.

## NOTES

**NOTES**

K44

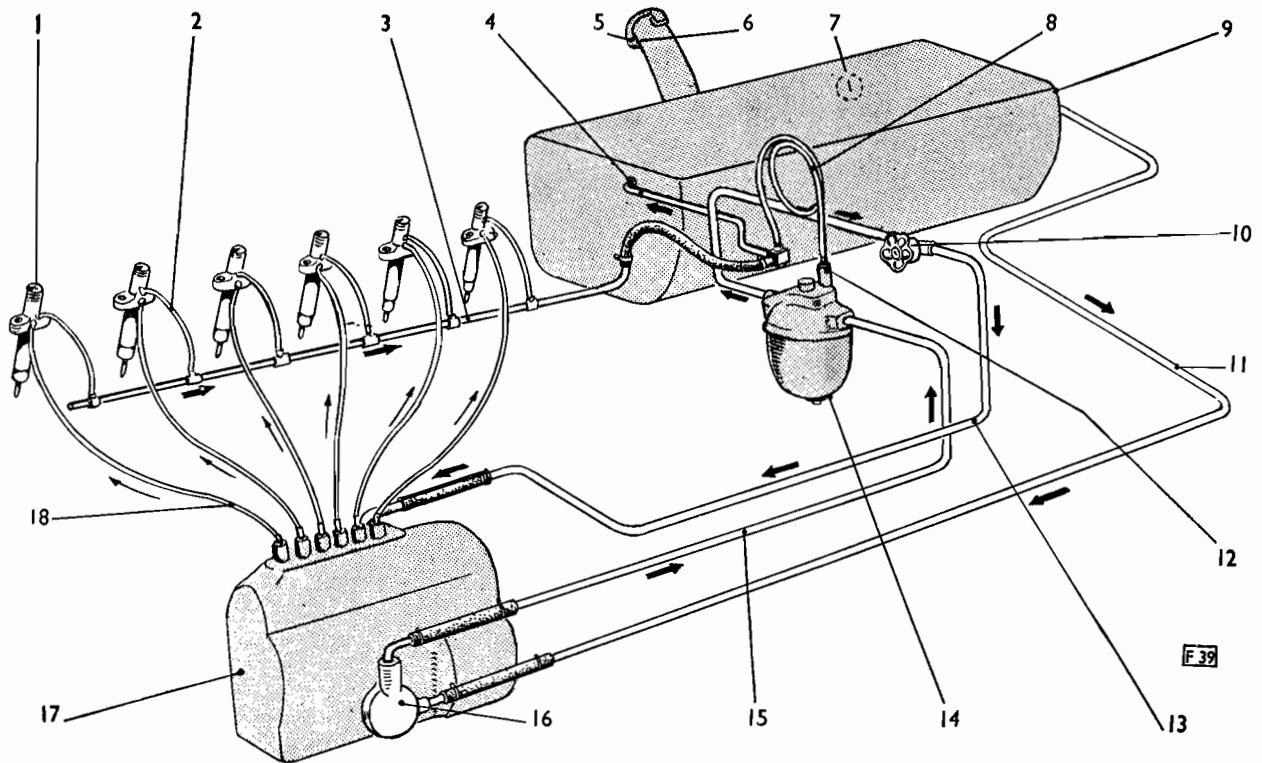
## NOTES

# PART N 24

## FUEL SYSTEM

### CONTENTS

	<i>Section</i>
Description .. .. .	1
Fuel Supply Tank:—	
To Remove and Fit .. .. .	2
Fuel Gauge:—	
To Remove, Adjust and Fit .. .. .	3
Fuel Stop Valve:—	
To Remove, Dismantle and Assemble .. .. .	4
Preliminary Fuel Filter:—	
To Remove, Clean and Fit .. .. .	5
Main Fuel Filters:—	
Description and Maintenance .. .. .	<i>See Parts A and B</i>
Fuel System:—	
To Vent .. .. .	<i>See Parts A and B</i>



**Key to Numbers:—**

- 1. INJECTOR
- 2. INJECTOR DRIBBLE PIPE
- 3. INJECTOR DRIBBLE GALLERY PIPE
- 4. FUEL RETURN PIPE
- 5. FILLER CAP
- 6. AIR VENT HOLE

- 7. FUEL GAUGE
- 8. AIR RELEASE RETURN PIPE
- 9. FUEL SUPPLY TANK
- 10. FUEL STOP VALVE
- 11. FUEL PIPE—FUEL SUPPLY TANK TO FUEL-LIFT PUMP
- 12. AIR RELEASE VALVE

- 13. FUEL PIPE—FILTER TO FUEL-INJECTION PUMP
- 14. MAIN FUEL FILTER
- 15. FUEL PIPE—FUEL-LIFT PUMP TO FILTER
- 16. FUEL-LIFT PUMP
- 17. FUEL-INJECTION PUMP
- 18. FUEL DELIVERY PIPE—FUEL-INJECTION PUMP TO INJECTOR

Fig. N1 Diagram of typical "Passenger" chassis fuel system with "In-line" type fuel-injection pump

## Section 1

## GENERAL DESCRIPTION

The fuel supply tank is frame mounted and fitted with a drain plug in the base, whilst a fuel gauge of the magnetic type is incorporated in the side or on the end of the tank.

The pointer of the fuel gauge is operated magnetically, there being no mechanical connection between it and the mechanism inside the tank, thus avoiding any possibility of leakage.

Single or twin type main fuel filters, mounted on the chassis frame or beneath the bonnet are incorporated in the system, the fuel being drawn from the supply tank by means of the lift pump and delivered to the filter(s).

Chassis destined to operate in dry and dusty conditions may have an additional preliminary filter and/or sedimentor (water separator) inserted in the fuel line between the fuel supply tank and fuel-lift pump.

Certain chassis are fitted with a fuel stop valve in the pipe line between the main fuel filter(s) and the

fuel-injection pump, by means of which the fuel supply to the pump can be shut off.

On chassis fitted with a "distributor" type fuel-injection pump a fuel "cut-off" device incorporated in the pump is operated by the driver by means of a hand control.

Fuel-injection pumps of either the "In line" or "Distributor" type are fitted.

Back leakage (or dribble) from the injectors is piped to a gallery pipe and returned to the supply tank.

A pipe, and on certain chassis an air release valve, fitted to the top of the main filter(s) is connected to this gallery pipe allowing any air bubbles to escape via the supply tank, but closing as soon as air-free fuel attempts to pass. On some late chassis a vent hole only is used.

## Section 2

## FUEL SUPPLY TANK

### To Remove

Drain the tank by removing the plug from the base.

Disconnect from the tank the fuel suction and return pipes.

Support the weight of the tank by means of wooden blocks on jacks.

The tank may be held in position by either hinged straps or clamping rods.

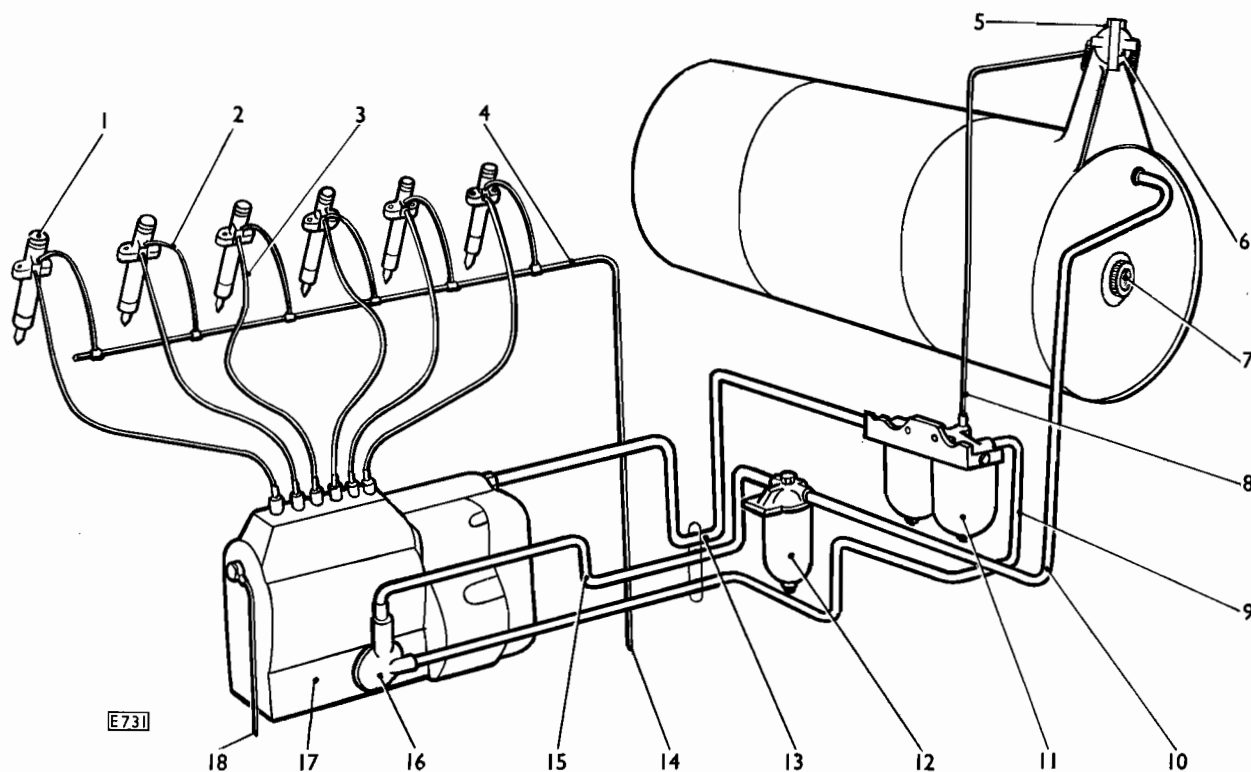
Where supporting straps are used remove the nuts securing the ends of the straps and swing them clear

of the tank. Where clamping rods are employed, slacken and remove the special type lock nuts securing the clamping rods on the outside of the tank.

Lower the tank to the ground.

### To Fit

Reverse the procedure for removal, renewing if necessary the packing strips for the straps, or the special type locknuts and plastic sleeves of the clamping rods. Finally vent the system as described in Part B.



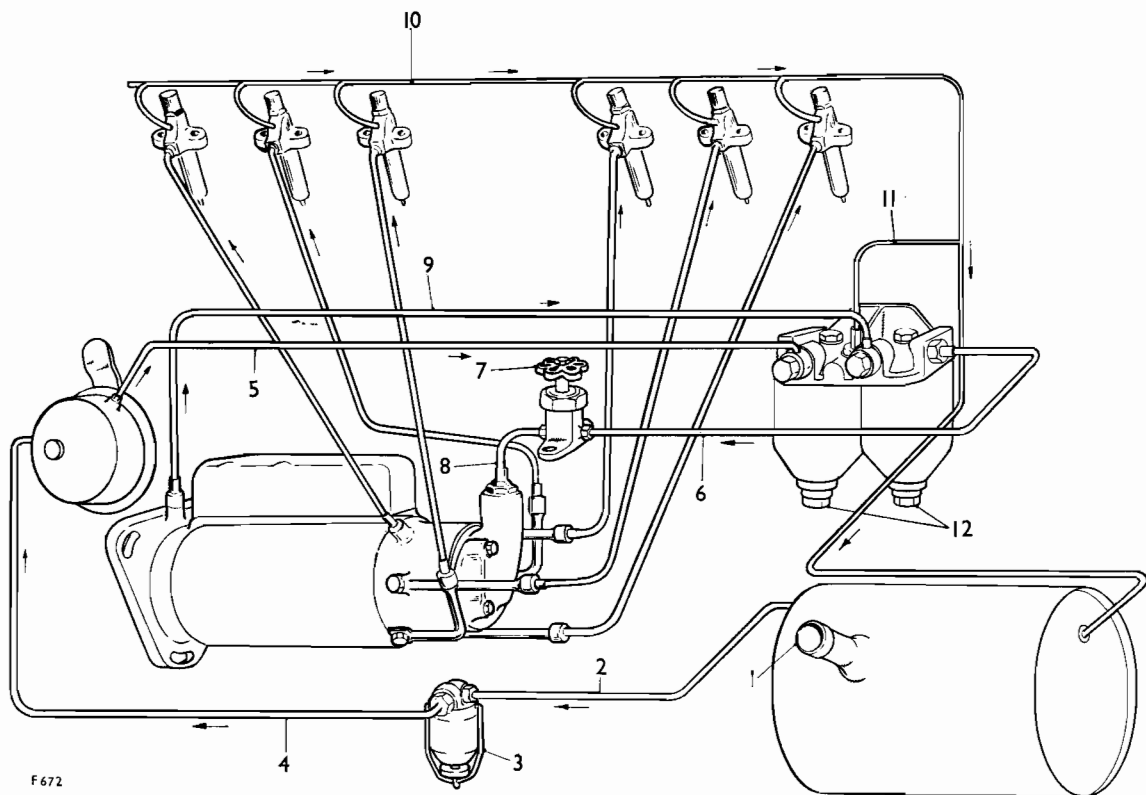
### Key to Numbers:—

1. INJECTOR
2. INJECTOR DRIBBLE PIPE
3. FUEL DELIVERY PIPE
4. INJECTOR DRIBBLE GALLERY PIPE
5. AIR VENT HOLE
6. FUEL SUPPLY TANK FILLER CAP

7. FUEL GAUGE
8. AIR RELEASE VENT PIPE
9. FUEL PIPE—FUEL-LIFT PUMP TO FILTER
10. FUEL PIPE—SUPPLY TANK TO FILTER
11. TWIN MAIN FUEL FILTERS
12. PRELIMINARY FUEL FILTER

13. FUEL PIPE—FILTER TO FUEL-INJECTION PUMP
14. GALLERY DRAIN PIPE
15. FUEL PIPE—FILTER TO FUEL-LIFT PUMP
16. FUEL-LIFT PUMP
17. FUEL-INJECTION PUMP
18. AIR VENT PIPE

Fig. N2 Diagram of typical "Goods" chassis fuel system with "In-line" type fuel-injection pump



**Key to Numbers:—**

- |   |  |   |
|---|--|---|
| 1. FUEL TANK FILLER PIPE AND CAP                        | 5. CONNECTION FROM FUEL-LIFT PUMP TO TWIN FILTER INLET | 9. EXCESS FUEL RETURN PIPE FROM FUEL-INJECTION PUMP TO TWIN FILTER INLET SIDE |
| 2. PIPE CONNECTING FUEL TANK TO PRELIMINARY FILTER      | 6. PIPE FROM TWIN FILTER OUTLET TO STOP VALVE          | 10. INJECTOR DRIBBLE RETURN PIPE TO FUEL TANK                                 |
| 3. PRELIMINARY FILTER                                   | 7. FUEL STOP VALVE                                     | 11. AIR VENT IN TWIN FILTER CASING  |
| 4. PIPE CONNECTING PRELIMINARY FILTER TO FUEL-LIFT PUMP | 8. PIPE FROM FUEL STOP VALVE TO FUEL-INJECTION PUMP    | 12. DRAIN PLUGS—TWIN FILTER CASING  |

**Fig. N3** Diagram of typical "Passenger" chassis fuel system with "Distributor" type fuel-injection pump

## Section 3

## FUEL GAUGE

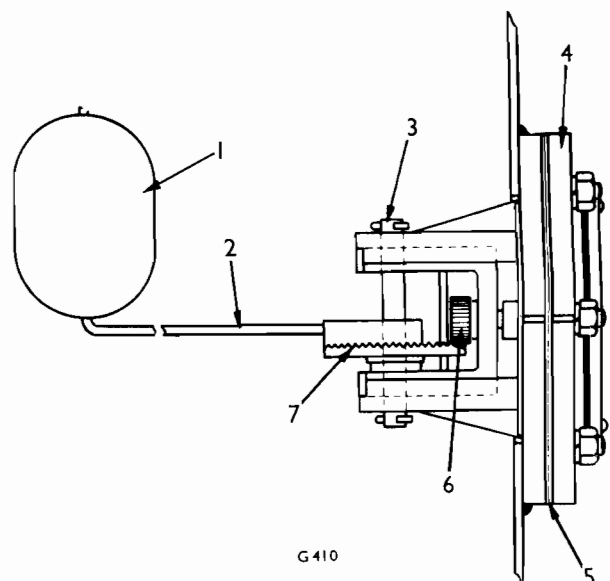
(See Fig. N4)

### To Remove

Drain the tank; the gauge can then be removed bodily by unscrewing the nuts securing the fixing flange. A gasket between the body of the instrument and the mounting flange ensures a fuel tight joint, and a washer inserted between the glass and the bezel, prevents the ingress of moisture to the dial.

### To Adjust

Remove the split pins and disconnect the spindle securing the driving gear.



**Key to Numbers:—**

- |                         |                  |
|-------------------------|------------------|
| 1. FLOAT                | 4. FIXING FLANGE |
| 2. FLOAT ARM            | 5. GASKET        |
| 3. DRIVING GEAR SPINDLE | 6. DRIVEN GEAR   |
|                         | 7. DRIVING GEAR  |

**Fig. N4** Fuel gauge mechanism

Mesh the two gears so that with the gauge inserted in the tank and the float resting on the bottom, the pointer is just touching the pin in the "EMPTY" position. If necessary, adjust the meshing of the gears the required number of teeth either way, until this result is obtained.

### To Fit

Reverse the procedure given for removal making sure that the cork float is in good condition, and that the gear mechanism operates freely. See also that the gasket between the instrument body and the fixing flange, and the washer between the glass and bezel are in good order.

## Section 4

### FUEL STOP VALVE (WHEN FITTED)

(See Fig. N6)

The fuel stop valve incorporates a fabric faced inner valve which is free to move in the valve body. By turning the operating handle in a clockwise direction the fabric face of the inner valve is brought into contact with an annulus in the valve body and provides a fuel tight seal, thus stopping the fuel supply to the fuel injection pump.

A laminated sealing disc is positioned beneath the valve body cap, to prevent fuel leakage between the valve body, valve body cap and along the spindle of the operating handle.

### To Remove

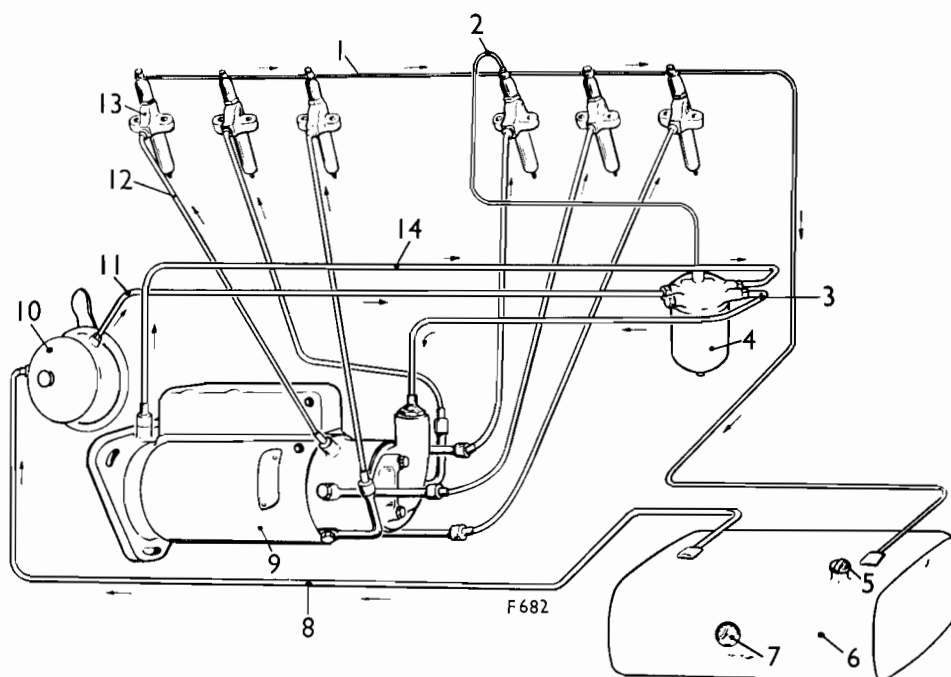
Disconnect the fuel suction pipes from the valve body. Unscrew the bolts from either the mounting flange or outrigger bracket and remove the valve.

### To Dismantle

Unscrew the valve body cap and lift out the laminated sealing disc, the valve and the two spring plates.

### To Assemble

Thoroughly clean the interior of the valve body and all other parts.



### Key to Numbers:—

- |  |   |  |
|--|---|--|
| 1. INJECTOR DRIBBLE GALLERY PIPE           | 6. FUEL SUPPLY TANK                             | 10. FUEL-LIFT PUMP                         |
| 2. AIR RELEASE VENT PIPE                   | 7. FUEL GAUGE                                   | 11. FUEL PIPE—FUEL-LIFT PUMP TO FILTER     |
| 3. FUEL PIPE—FILTER TO FUEL-INJECTION PUMP | 8. FUEL PIPE—FUEL SUPPLY TANK TO FUEL-LIFT PUMP | 12. FUEL DELIVERY PIPE                     |
| 4. MAIN FUEL FILTER                        | 9. D.P.A. FUEL-INJECTION PUMP                   | 13. INJECTOR                               |
| 5. FILLER CAP                              |   | 14. FUEL PIPE—EXCESS FUEL RETURN TO FILTER |

Fig. N5 Diagram of typical "Goods" chassis fuel system with "Distributor" type fuel-injection pump

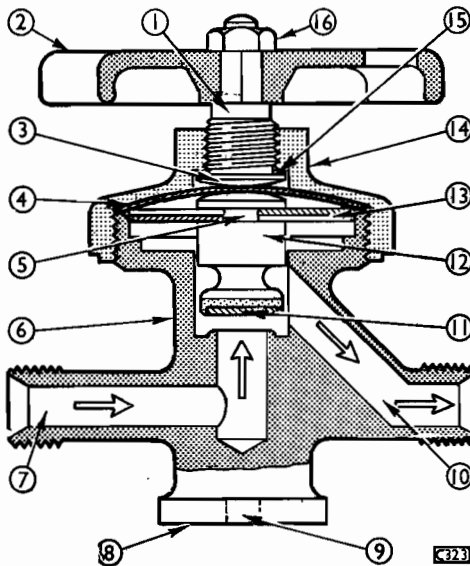
Place the spring plates on the neck of the valve with the tag of one plate interlocking with the slot of the other and insert the valve into the valve body.

Place the laminated sealing disc on top of the valve, with the stainless steel layer between the phosphor bronze layers. Ensure that the spindle of the operating

handle is in the fully open position; then screw on the valve body cap.

#### To Fit

Reverse the procedure for removal and vent the fuel system (*see Part B*).



#### Key to Numbers:—

1. CONTROL HANDLE SPINDLE
2. CONTROL HANDLE
3. HEAD OF CONTROL HANDLE SPINDLE
4. LAMINATED SEALING DISC
5. VALVE NECK
6. VALVE BODY
7. FUEL INLET FROM TWIN FUEL FILTERS
8. MOUNTING FLANGE
9. MOUNTING BOLT HOLE
10. FUEL OUTLET TO FUEL-INJECTION PUMP
11. FABRIC FACE
12. VALVE
13. SPRING PLATES
14. VALVE BODY CAP
15. WASHER
16. NUT SECURING CONTROL HANDLE SPINDLE

Fig. N6 Section through fuel stop valve

## Section 5

### PRELIMINARY FUEL FILTER (WHEN FITTED)

(*See Fig. N7*)

The following instructions apply to certain chassis where a preliminary fuel filter is incorporated in the fuel pipe line.

#### To Remove

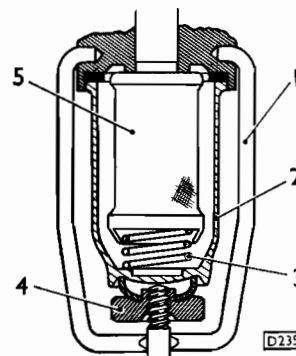
Unscrew the knurled knob which supports the preliminary filter and move the stirrup so that the bowl, together with the filtering element can be removed.

#### To Clean

**Thoroughly** wash the bowl and filter with clean fuel oil and allow to drain.

#### To Fit

Reverse the procedure for removal and vent the fuel system (*see Part B*).



#### Key to Numbers:—

1. STIRRUP
2. FILTER BOWL
3. SPRING
4. KNURLED NUT
5. FILTER ELEMENT

Fig. N7 Section through typical preliminary filter

## NOTES

## NOTES

# PART R51

## PEDAL GEAR

### CONTENTS

	<i>Section</i>
Pedal Gear .. .. .	1
To Remove and Dismantle.	
To Assemble and Fit.	

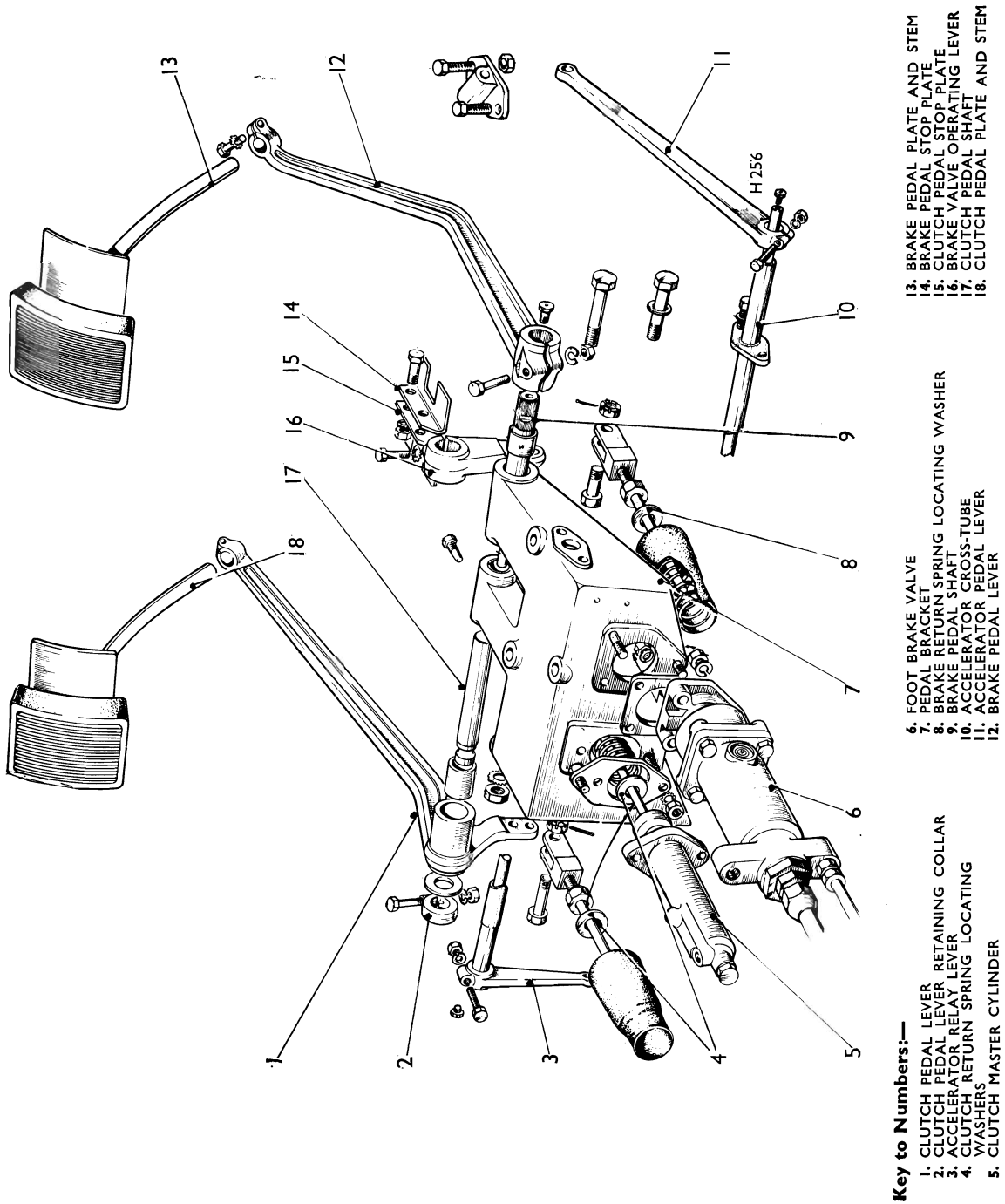


Fig. R1 Exploded view of pedal gear—right hand control chassis

## Section 1

### PEDAL GEAR

(see Figs. R1 and R2.)

#### To Remove

**Note.**— When this chassis is adapted for **passenger use**, and no tilt cab is fitted, access can be gained to the pedal gear by removing the floor plate. It should also be noted that when a passenger chassis is fitted with a direct-acting type gearbox, the clutch pedal assembly is **not** fitted; all references to the clutch operation in the following text should be ignored.

Tilt the cab.

Isolate the batteries by operating the isolating switch (when fitted) or by disconnecting the cables from the terminal posts on the batteries and taping them clear.

Drain the **entire** air pressure system as instructed in Part A.

Prise the dust cap out of the steering wheel centre with a screwdriver; remove the retaining nut and washer from the shaft and lift off the steering wheel.

Remove the support from the rear of the instrument binnacle.

Remove the clutch and brake pedal plate and stem assemblies and disconnect the accelerator pedal from the link, then remove the rubber floor surround.

Disconnect the dipswitch cable and remove the setscrews securing the forward section of the driver's floor plate; remove the plate.

Remove the setscrews from the base of the pedestal, disconnect the oil and air pressure gauge pipes, the auxiliary brake hand control pipes (when fitted) and the snap connected multi-pin plugs at the pedestal base; then carefully lift the instrument binnacle and pedestal up the steering column to permit the raising of the driver's floor section. If necessary, disconnect the clips securing the cable loom to the floor to facilitate this operation. Support the binnacle and pedestal in the raised position with a sling attached to a convenient part of the cab.

Remove the driver's seat from the floor, then remove the nuts and bolts securing the rear of the floor to the frame and the setbolts securing the floor centre to the pedal bracket.

Disconnect the "diff-lock" (when fitted) and the engine stop control, also ascertain that the cable looms passing through the rear of the floor to the control unit, buzzer, flasher unit and junction box are sufficiently "free" to permit the raising of the floor; if necessary disconnect the clips and/or cables.

Using a suitable lifting tackle and sling, raise the floor sufficiently to obtain easy access to the pedal

assembly; retain the triangular packing plate fitted between the floor and the pedal bracket.

Disconnect the accelerator lever from the accelerator rod on the inside of the chassis.

Disconnect the pipes from the brake valve; cover the pipe ends to prevent the ingress of foreign matter.

Drain the clutch operating fluid from the slave cylinder into a clean container (*see Part C*) and disconnect the pipes from the clutch master cylinder; cover the pipe ends to prevent the ingress of foreign matter.

Support the weight of the pedal gear and remove the nuts and bolts securing it to the chassis side member, lift the assembly from the chassis.

#### To Dismantle

Clamp the pedal gear in a vice.

Remove the brake valve as instructed in Part K, retaining the pedal return spring, its locating washer and the rubber gaiter.

Withdraw the split pin from the brake operating rod fork end and remove the pin; **on no account should the fork end adjustment be altered.**

Remove the clutch master cylinder as instructed in Part C, retaining the adaptor plate, pedal return spring, locating washers and the rubber gaiter.

**Right-hand control chassis** (*see Fig. R1*).

Remove the clamp bolt from the clutch pedal retaining collar and withdraw the collar, washer and pedal lever from the shaft.

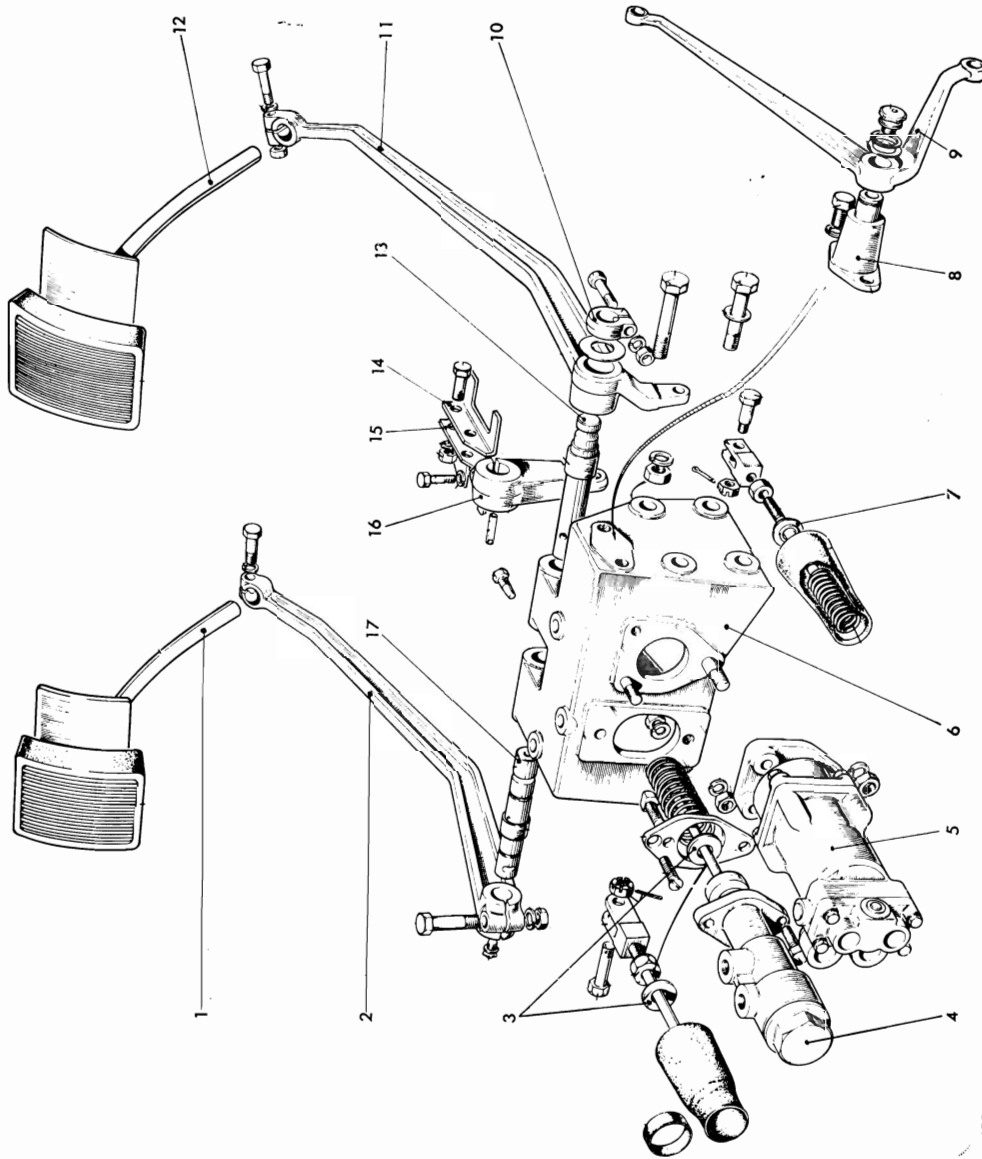
Unfasten the lockwire (when fitted) and remove the clutch pedal shaft locking screw, then withdraw the shaft from the pedal bracket, retaining the lubrication transfer pipe fitted between the clutch and brake pedal shafts.

Remove the lubricator from the brake pedal shaft.

Mark the relationship between the brake pedal lever and the pedal shaft to facilitate assembly, then remove the clamp bolt and withdraw the lever from the shaft.

Similarly, mark the relationship between the brake valve operating lever and the pedal shaft, remove the clamp bolt and, using a soft metal drift through the clutch pedal shaft bore, drive the shaft from the lever and the bracket.

Remove the lubricator from the pedal lever end of the accelerator cross-shaft.



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**Key to Numbers:—**

- |  |                                       |  |
|--|---------------------------------------|--|
| 1. CLUTCH PEDAL LEVER PLATE AND STEM     | 7. BRAKE PEDAL RETURN SPRING LOCATING | 12. BRAKE PEDAL PLATE AND STEM             |
| 2. CLUTCH PEDAL LEVER                    | 8. WASHER-ACCELERATOR PEDAL LEVER     | 13. SHAFT—BRAKE PEDAL                      |
| 3. CLUTCH RETURN SPRING LOCATING WASHERS | 9. STOP PLATE—ACCELERATOR PEDAL       | 14. STOP PLATE—BRAKE PEDAL                 |
| 4. CLUTCH MASTER CYLINDER                | 10. COLLAR—BRAKE PEDAL                | 15. STOP PLATE—CLUTCH PEDAL                |
| 5. FOOT BRAKE VALVE                      | 11. BRAKE PEDAL LEVER                 | 16. CLUTCH MASTER CYLINDER OPERATING LEVER |
| 6. PEDAL BRACKET                         |                                       | 17. SHAFT—CLUTCH PEDAL                     |

**Fig. R2** Exploded view of pedal gear—left-hand control chassis.

Mark the relationship between the accelerator pedal lever and the shaft to facilitate assembly and remove the lever.

Withdraw the cross-shaft complete with the accelerator relay lever from the cross-tube. If necessary, remove the lubricator, mark the relationship between the lever and the shaft and press the shaft from the lever.

Unfasten the lockwire (when fitted) and remove the setbolts securing the cross-tube to the pedal bracket. Mount the bracket on its side and, using a hammer and a suitable soft metal drift, drive the tube from the bracket.

#### **Left-hand control chassis** (see Fig. R2)

Remove the clamp bolt from the brake pedal retaining collar and withdraw the collar, washer and pedal lever from the shaft.

Remove the brake pedal shaft locking screw, then withdraw the shaft from the pedal bracket, retaining the lubrication transfer pipe fitted between the brake and clutch pedal shafts.

Remove the lubricator from the clutch pedal shaft.

Remove the clamp bolt from the clutch pedal lever and withdraw the lever from the shaft.

Mark the relationship between the clutch master cylinder operating lever and the pedal shaft, remove the clamp bolt and, using a soft metal drift through the brake pedal shaft bore, drive the shaft from the lever and the bracket.

Remove the lubricator from the end of the accelerator pedal lever spigot.

Mark the relationship between the accelerator pedal lever and its spigot to facilitate assembly; remove the circlip and washer and withdraw the lever from the spigot.

If necessary, detach the spigot from the pedal bracket by removing the setbolts and washers.

#### **Right and left-hand control chassis** (see Figs. R1 and R2)

If necessary, remove the clutch and brake pedal stop plates from the bracket noting their relative positions.

#### **To Assemble**

Reverse the procedure for dismantling noting the following points:—

Examine the clutch pedal lever and the pedal bracket bushes for wear and replace, if necessary.

Ensure that all marks made on dismantling are correctly aligned and that all levers are secured by their respective clamp bolts.

When fitting the clutch pedal shaft ensure that the lubrication transfer pipe is fitted between this shaft and the brake pedal shaft.

Lock the accelerator cross-tube retaining setbolts and the clutch pedal shaft locking screw with wire (when fitted).

Before refitting the brake operating valve and the clutch master cylinder, check that the levers and shafts move freely and without hard spots.

Fit the adaptor plate between the clutch master cylinder and the pedal bracket; fit the spring locating washer onto the operating rod with the shoulder facing **away** from the cylinder and fit the pedal return spring. Locate the bead in the rubber gaiter around the groove in the spring locating washer ensuring that the shoulder faces **inwards**. Fit the gaiter over the spring and fit the locknut and fork end. Check that the spring locates on the washer shoulders.

Adjust the fork end as instructed in Part C.

Similarly, fit the brake pedal return spring, locating washer and gaiter, noting that the washer is fitted at the fork end only, as the spring locates inside the valve at its opposing end.

Check the adjustment of the push rod as instructed in Part K.

Lock the fork end pins with split pins.

#### **To Fit**

Reverse the procedure for removal noting the following points:—

Ensure that the triangular packing plate is fitted between the top of the pedal bracket and the underside of the floor; temporary dowels should be used to assist in lining up the holes.

Check that all wires and pipes are connected and cable looms secured.

Fit the **longer** of the pedal plate and stem assemblies to the clutch lever and bleed the clutch as instructed in Part C.

Fit the steering wheel as instructed in Part A.

## NOTES

**NOTES**

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## NOTES

## PART S72

# LUBRICATION

### CONTENTS

	<i>Section</i>
General Description .. .. .	1
Recommended Lubricants .. .. .	2

## Section 1

## GENERAL DESCRIPTION

The standard method of chassis lubrication for the main units is by filler and level plugs, and by pressure gun to individual lubricators for the remaining points, some of which are grouped for easy access.

The location of all lubricators and the type of lubricant required for each is indicated on the Lubrication Chart at the end of the book.

The use of two pressure guns (listed in the Maintenance Equipment) is recommended; one for oil and the other for grease.

Automatic lubrication systems, operated either by vacuum or compressed air in connection with the chassis braking system, or belt driven from the propeller shaft are fitted by special request; with chassis so equipped, reference should be made to the appropriate Lubrication Chart and Supplement to this Part.

**For Capacities and Periodical Oil Changes of Main Units see Part A.**

## Section 2

## RECOMMENDED LUBRICANTS

It is not the policy of this company to recommend the products of any particular supplier, but the principal oil companies will, on application, provide a lubricant which conforms to any of the specifications given in this Section.

**It is recommended that a detergent type lubricating oil should be used in the engine, but mixing of different brands should be avoided unless it is assured that they all conform to the appropriate specification given hereafter.**

**NOTE.**—Engines should be filled with a detergent type oil conforming to one of the following ENGINE OIL specifications, according to the mean air temperature in which the unit is to operate. Other units which require a GENERAL PURPOSE engine type oil should at all times be filled with an oil conforming to A.E.C. Specification No. L13 (or L19 if desired), with the following exceptions:— Power Assisted Steering Hydraulic System—A.E.C. Specification No. L21 (except for bonnetted vehicles: for Specification see Part A of the Maintenance Handbook), and for Tipping Gear units, when fitted, use SAE 5 for normal temperatures but for temperatures above 90° F (32° C) use SAE 10 and below 5° F (minus 15° C), use Light Hydraulic oil.

**Refer to the Supplement to this Part when Syndromic Automatic lubrication is fitted.**

**Operators should satisfy themselves that the lubricants they use, conform to the requirements of the following specifications.**

### SPECIFICATIONS FOR OILS SUITABLE FOR ALL A.E.C. NORMALLY ASPIRATED ENGINES WITH THE EXCEPTION OF TYPE A1100.

#### A.E.C. Specification No. L19

**SAE 30 HD Detergent Type Oil for use where the atmospheric temperature normally exceeds 90° F. (32·2° C.).**

The oil subject to this specification shall meet either Ministry of Defence Specification DEF 2101C and/or United States Ordnance Department Specification MIL-L-2104A, and must also comply in full to the physical requirements of both these specifications.

#### A.E.C. Specification No. L20

**SAE 20W HD Detergent Type Oil for use where the atmospheric temperature is normally between 20° F. (minus 6·7° C.) and 90° F. (32·2° C.).**

The oil subject to this specification shall meet Ministry of Defence Specification DEF 2101C. Alternatively, while still meeting the full requirements

of Ministry of Defence Specification DEF 2101C, it may be prepared from a suitable blend of SAE 10 and SAE 30 grade oils each of which meet the United States Ordnance Department Specification MIL-L-2104A.

#### A.E.C. Specification No. L22

**SAE 10W HD Detergent Type Oil for use where the atmospheric temperature is normally below 20° F. (minus 6·7° C.).**

The oil subject to this specification shall meet either Ministry of Defence Specification DEF 2101C and/or United States Ordnance Department Specification MIL-L-2104A, and must also comply in full to the physical requirements of both these specifications.

#### A.E.C. Specification No. L29

**SAE 10W/30, Multigrade Type Oil for use where the atmospheric temperature is normally between 0° F. (minus 17·8° C.) and 90° F. (32·2° C.).**

The oil subject to this specification shall meet the performance requirements of either Ministry of

Defence Specification DEF 2101C and/or United States Ordnance Department Specification MIL-L-2104A, and must also comply with the engine performance tests required by these specifications.

**SPECIFICATIONS FOR OILS SUITABLE FOR ALL A.E.C. TURBOCHARGED ENGINES WITH THE EXCEPTION OF TYPE A1100 TURBOCHARGED ENGINE.**

THESE OILS ARE ALSO APPLICABLE TO THE NORMALLY ASPIRATED TYPE A1100 ENGINE, AND IF DESIRED, MAY ALSO BE USED IN OTHER A.E.C. NORMALLY ASPIRATED ENGINES.

**A.E.C. Specification No. L25**

SAE 10W, Supplement 1, Type Oil for use where the atmospheric temperature is normally below 20° F. (minus 6.7° C.).

The oil subject to this specification shall meet either Ministry of Defence Specification DEF 2101C and/or United States Ordnance Department Specification MIL-L-2104A, wherein the diesel engine test is modified by using a fuel of between 0.95% and 1.05% sulphur content, and must also comply in full to the physical requirements of both these specifications.

**A.E.C. Specification No. L26**

SAE 20W, Supplement 1, Type Oil for use where the atmospheric temperature is normally between 20° F. (minus 6.7° C.) and 90° F. (32.2° C.).

The oil subject to this specification shall meet Ministry of Defence Specification DEF 2101C, wherein the diesel engine test is modified by using a fuel of between 0.95% and 1.05% sulphur content. Alternatively, while still meeting the full requirements of Ministry of Defence DEF 2101C, it may be prepared from a suitable blend of SAE 10 and SAE 30 grade oils each of which meet the United States Ordnance Department Specification MIL-L-2104A also using 0.95% to 1.05% sulphur content fuel.

**A.E.C. Specification No. L27**

SAE 30, Supplement 1, Type Oil for use where the atmospheric temperature normally exceeds 90° F. (32.2° C.).

The oil subject to this specification shall meet either Ministry of Defence Specification DEF 2101C and/or United States Ordnance Department Specification MIL-L-2104A, wherein the diesel engine test is modified by using a fuel of between 0.95% and 1.05% sulphur content, and must also comply in full to the physical requirements of both these specifications.

**SPECIFICATIONS FOR OILS SUITABLE FOR THE A.E.C. TURBOCHARGED ENGINE TYPE A1100.**

**A.E.C. Specification No. L30**

SAE 10W Series III, Type Oil for use where the atmospheric temperature is normally below 20° F. (minus 6.7° C.).

The oil subject to this specification must have the approval of the Caterpillar Tractor Co. Ltd., as Superior Lubricant Series III, or alternatively must have been approved as conforming to the requirements of the United States Ordnance Specification MIL-L-45199.

**A.E.C. Specification No. L31**

SAE 20W Series III, Type Oil for use where the atmospheric temperature is normally between 20° F. (minus 6.7° C.) and 90° F. (32.2° C.).

The oil subject to this Specification may be prepared from a suitable blend of SAE 10 and SAE 30 oils, each of which must have the approval of the Caterpillar Tractor Co. Ltd., as Superior Lubricants Series III, or alternatively must have been approved as conforming to the requirements of the United States Ordnance specification MIL-L-45199.

**A.E.C. Specification No. L32**

SAE 30, Series III, Type Oil for use where the atmospheric temperature normally exceeds 90° F. (32.2° C.).

The oil subject to this specification must have the approval of the Caterpillar Tractor Co. Ltd., as Superior Lubricant Series III, or alternatively must have been approved as conforming to the requirements of the United States Ordnance Specification MIL-L-45199.

**SPECIFICATIONS FOR GENERAL PURPOSE OILS**

**A.E.C. Specification No. L13**

**SAE 30 Non-detergent Type Oil**

The following additional characteristics are essential.

Viscosity Index	.. ..	90 minimum.
Closed Flash Point	.. ..	400° F. (204.4° C.) minimum.
Pour Point	.. ..	15° F. (minus 9.4° C.) maximum.
Acidity (organic)	.. ..	0.10 mgms. KOH per gm. maximum.
Ash	.. ..	0.005 per cent. maximum.
Carbon Residue (Ramsbottom)	.. ..	0.5 per cent. maximum.

**Oxidation Characteristics:—**

Viscosity Ratio at 140° F. (60° C.) .. .. .	1.5 maximum.
Increase in Carbon Residue	0.7 per cent. maximum.
Asphaltenes in Oxidised Oil	0.05 per cent. maximum.

**A.E.C. Specification No. L21****SAE 10W Non-detergent Type Oil for use in Power Assisted Steering Hydraulic System.**

The following additional characteristics are essential:—

Viscosity Index .. .. .	90 minimum.
Pour Point .. .. .	Minus 5° F. (minus 20.6° C.).

**EPICYCLIC GEAR BOX OIL**

For a suitable grade of lubricant, operators are advised to apply direct to any reputable oil company for their recommendation.

**SPECIFICATION FOR WORM GEAR OIL****A.E.C. Specification No. L17**

**SAE 140 Oil for use where the atmospheric temperature is normally below 90° F. (32.2° C.).**

*Description.*—To be a pure hydrocarbon oil thoroughly filtered to remove all solid matter, and to be entirely free from water, dirt, suspended matter or any other impurities. To be free from mineral acidity.

*Characteristics.*—When tested by the appropriate methods given in the current issue of the Institute of Petroleum's "Standard Methods for Testing Petroleum and its Products," the oil must conform with the following requirements:—

Viscosity (Redwood No. 1) at 140° F. (60° C.) .. .. .	550—625 seconds (135—155 centistokes).
Viscosity (Redwood No. 1) at 200° F. (93.3° C.) .. .. .	150 seconds minimum (36 centistokes).
Viscosity Index .. .. .	95 minimum.
Pour Point .. .. .	15° F. (minus 9.4° C.) maximum.
Closed Flash Point .. .. .	475° F. (246.1° C.) minimum.
Acidity (organic) .. .. .	0.10 mgms. KOH per gm. maximum.
Ash .. .. .	0.005 per cent. maximum.

**Oxidation Characteristics:—**

Viscosity Ratio at 140° F. (60° C.) .. .. .	1.5 maximum.
Asphaltenes in Oxidised Oil	0.05 per cent. maximum.

**SPECIFICATION FOR "HYPOID 90"  
GEAR OIL****A.E.C. Specification No. L23****SAE 90**

*Description.*—To be a pure hydrocarbon oil thoroughly filtered to remove all solid matter or any other impurities. To be free from mineral acidity. The oil should be blended with a load carrying additive recommended by the oil supplier.

*Characteristics.*—When tested by the appropriate methods recommended by the American Co-ordinating Research Council (with such modifications as may be necessary when applying these methods of test in the United Kingdom), the oils shall meet the acceptance standards required by the United States Ordnance Department's specification MIL-L-2105.

Viscosity (Redwood No. 1) at 210° F. (98.9° C.) .. .. .	71—80 seconds (15.6—18 centistokes).
Closed Flash Point .. .. .	325° F. (162.8° C.) minimum.
Viscosity Index .. .. .	85 minimum.
Channel Point .. .. .	0° F. (minus 17.7° C.) maximum.

Copper Strip Corrosion Test Negative.

**SPECIFICATION FOR WORM GEAR OIL FOR  
USE AT HIGH OPERATING TEMPERATURES****A.E.C. Specification No. L28**

**SAE 250 Oil for use where the atmospheric temperature normally exceeds 90° F. (32.2° C.).**

*Description.*—To be a pure hydrocarbon oil thoroughly filtered to remove all solid matter, to be entirely free from water, dirt, suspended matter or any other impurities. To be free from mineral acidity.

*Characteristics.*—When tested by the appropriate methods given in the current issue of the Institute of Petroleum's "Standard methods for Testing Petroleum and its Products," the oil must conform with the following requirements:—

Specific gravity .. .. .	0.925 maximum.
Viscosity (Redwood No. 1) at 140° F. (60° C.) .. .. .	Not more than 1,500 seconds.
Viscosity (Redwood No. 1) at 200° F. (93.3° C.) .. .. .	Not less than 240 seconds.
Open Flash Point .. .. .	575° F. (301.7° C.) minimum.
Ash .. .. .	0.01 % maximum.
Pour Point .. .. .	35° F. (1.7° C.) maximum.

## SPECIFICATION FOR GREASE— HIGH MELTING POINT

### A.E.C. Specification No. L24

*Scope.*—Grease supplied against this specification shall have good mechanical stability and be suitable for use in grease lubricated points on heavy road vehicle chassis, including the roller bearings of wheel hubs.

*Description.*—The grease to be a smooth, homogeneous preparation possessing no bad odour. The grease to be prepared from refined and filtered mineral oil, together with saponifiable materials of good quality, saponified with a good grade basic compound of lithium. Rosin or rosin oil must not be present. The grease to be entirely free from grit and from mineral filling matter, to exhibit no undue tendency to separate during storage, and also no tendency to emulsify with water.

*Characteristics.*—When tested by the appropriate methods given in the current issue of the Institute of Petroleum's "Standard Methods for Testing Petroleum and its Products," the grease must conform to the following requirements:—

Soap Base .. .. .	Lithium.
Drop Point .. .. .	356° F. (180° C.) minimum.

Worked Penetration after 60 double strokes .. ..	265-295 units.
Worked Penetration after 5000 double strokes ..	Not softer than 320 units.
Viscosity of Mineral Oil at 210° F. (99° C.) .. ..	9.7—21.0 centistokes.
Ash (sulphated) .. ..	3.0% maximum.
Water .. .. .	0.2% maximum.
Free acid .. .. .	To be entirely absent.
Free alkali .. .. .	0.1% maximum, calculated as lithium hydroxide.
Copper strip corrosion ..	To pass test (see appendix).

### Appendix

#### Corrosion Test for Grease

The test shall be carried out as described in I.P. 112. It shall be conducted at room temperature, the period of immersion of the copper test piece in the grease being 72 hours. At the conclusion of the test, the copper strip shall show no signs of etching, pitting, or discoloration.

**Note.**—All greases to this specification must meet the requirements of the **BRITISH TIMKEN** approval tests.

**NOTES**

**NOTES**

NOTES

## PART O 22

(THIS PART SUPERSEDES PARTS O16, O17 AND O25)

# ELECTRICAL EQUIPMENT

FOLIO O1/1

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**Note.**—When BUTEC alternator and starter motor equipment is used, refer to Folios 02/23 and 03/9 respectively.

## Section 1

## GENERAL DESCRIPTION

The vehicle is wired on the 24V insulated return system and where necessary the cables are enclosed in oil-resistant plastic tubing. Clips which are readily removable are used to secure each cable harness to the frame. Where appropriate the cable entries are through tight-fitting rubber bushes and gland nuts.

Depending upon customers' requirements either C.A.V., Simms or BUTEC equipment is fitted. Usually it includes the main control unit; the regulator and cut-out, or transistorised control unit; the distribution board; battery cut-off switch; main and subsidiary fuses and the switch gear.

All equipment supplied with the chassis is included on the Wiring Diagram (*see end of Book*) but detailed instructions relating to certain special items supplied by the body-builders, such as wind-screen wipers, cannot be covered by this Manual.

Electrical supply is from a 24V battery comprising either four 6V or two 12V units connected in series (*for details see Part A*). Operational battery charging is by the dynamo, or an alternator with a built-in or separate rectifier. The output of the dynamo is governed by current-voltage control or by compensated-voltage regulators, whereas alternator output may also be governed by a transistorised control unit. On most vehicles these are housed in the main control unit of the system but, on others, they are located on the frame in a separate control box.

The axial-type starter motor is operated by a built-in solenoid switch controlled by the driver's push button.

With engine mounted dynamos, or alternators, a belt drive is used except for the 7.7 litre engine with which the drive is by the timing chain. Frame mounted, dynamos or alternators, are either belt driven or if a drive box for auxiliaries is fitted they are shaft driven (*see Part B*.)

Normally, the instruments are indirectly illuminated by two lights mounted in the panel. If, however, an oil pressure warning light is fitted, it also serves as a panel light.

Vehicles equipped with "Monocontrol" transmission have a C.A.V. gear selector switch secured to the instrument panel on the steering column adjacent to the driver's hand; and a C.A.V. electro-pneumatic valve unit which is mounted on the rear of the direct-acting gearbox casing.

Should it ever become necessary to renew any unit of the equipment, it is important to see that the replacement unit bears similar type and symbol markings. If in any doubt about this, advice will be gladly given by any A.E.C. Depot or Agent (*for addresses see separate leaflet*).

**Note.**—All electrical connections and cable entries are externally protected by a special sprayed-on sealant. This sealant can be removed by a suitable spirit solvent.

When reconnecting, the sealant, which is non-conducting, must **NOT** be deposited on any contact points.

Supplies of the sealant can be obtained from any AEC Depot or Agent.

**For Wiring Diagram see Plate at end of Book**

## GENERAL INSTRUCTIONS

### Section 2

### ALTERNATOR, DYNAMO AND STARTER MOTOR —SERVICING

#### (A) ALTERNATOR SLIP RINGS

**To Clean.** Remove the slip ring end cover and circlip; blow out the slip ring compartment with dry, clean compressed air. Examine the slip rings for pitting and scoring.

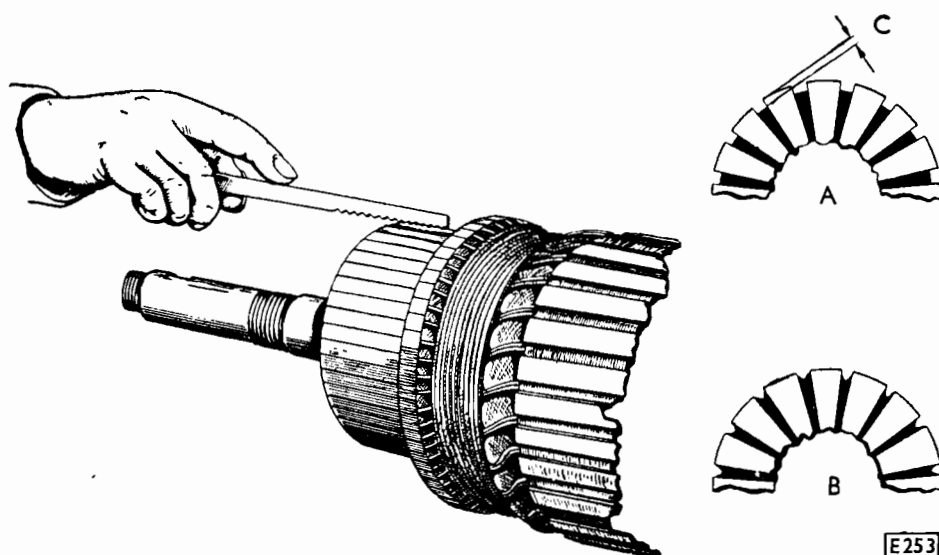
**Note.**—Operations such as skimming or renewal of the slip rings and insulation tests should be performed only by qualified personnel trained by the makers of the alternator.

#### (B) DYNAMO AND STARTER COMMUTATORS

(a) **To Clean.** The commutator surface should be

clean and free from black discolouration; a dark chocolate colour is, however, quite normal. The surface may be cleaned with a rag dipped in petrol or, if necessary, with very fine glass or carborundum paper, **not emery cloth**.

(b) **To Skim.** If the commutator surface is pitted, the armature should be set up in a lathe and the commutator skimmed. To ensure that the commutator surface remains concentric with the shaft during this operation it is advisable to support the armature in the lathe in ball bearings rather than between centres.



**Key to Letters:—**

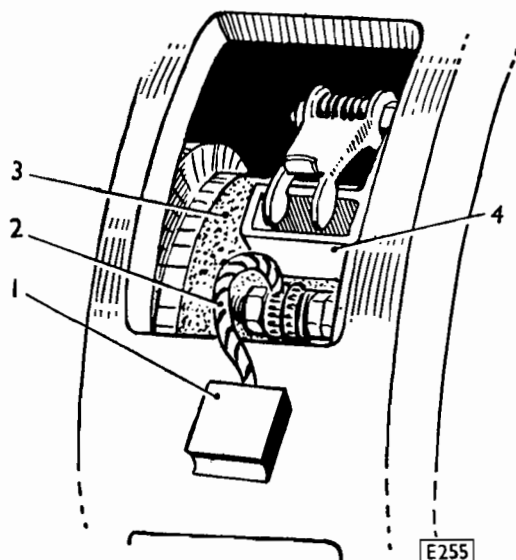
- A. CORRECT WAY, SHOWING FULL WIDTH OF MICA REMOVED
- B. INCORRECT WAY
- C. DEPTH OF UNDERCUT  $\frac{1}{32}$  in. (0.80 mm.)

**Fig. O1 Method of undercutting commutator mica**

Only a light cut should be taken and, where possible, a diamond tool used to provide the necessary high quality finish. Alternatively, the tool must be sufficiently keen to leave a smooth surface, after which the commutator should be polished with a strip of very fine carborundum paper.

(c) **To Undercut.** After turning, the commutator must be undercut, i.e. the mica insulation between the commutator bars must be removed to a depth of  $\frac{1}{32}$  in. (1 mm.) below the surface of the copper, care being taken to ensure that the full width of mica is removed and that nothing is left to project above the copper. A suitable tool for this operation usually takes the form of a short saw blade with handle and a heavy reinforced back to the blade in order to assist steadiness in use. If this tool is not available an old hacksaw blade, ground to the width of the mica, will make a serviceable tool (*see Fig. O1*). After undercutting, any burrs must be removed by polishing the commutator with fine carborundum paper.

tions, when fitted. If movement is not perfectly free, remove the brush from its holder and lightly polish its sides on a smooth file. Always replace the brushes exactly in their original positions. If the brushes are so worn that they do not bear on



**Key to Numbers:—**

- 1. BRUSH
- 2. PIGTAIL
- 3. CARBORUNDUM PAPER
- 4. BRUSH HOLDER

**Fig. O2 Method of "bedding" dynamo and starter motor brushes**

**(C) BRUSHES**

(a) **To Check for Freedom.** Brushes must be free in their boxes. Hold back the brush springs or triggers and move each brush up and down in its holder by pulling gently on their flexible connec-

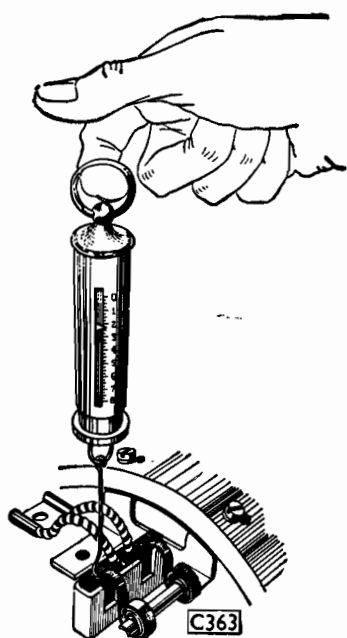


Fig. O3 Method of checking brush spring pressures

the commutator, or slip rings, or do not allow full pressure to be exerted by the spring, new brushes must be fitted.

**(b) To Bed.** Brushes must be well “bedded,” i.e. they must conform to the commutator, or slip ring, periphery. When new brushes are fitted, or if existing ones need “bedding”, wrap a strip of very fine glass or carborundum paper (**not emery cloth**), firmly around the commutator, or slip rings, abrasive surface towards the brushes. Then, with the brushes in position, rotate the armature, or rotor, **by hand** in the normal working direction of rotation until the correct brush shape is obtained (*see Fig. O2*).

**(c) To Check the Brush Spring Pressures.** Test the brush spring pressures by means of a spring balance hooked under the tip of each brush spring or trigger (*see Fig. O3*). The pressure should be as shown in Sections 7 and 10. If the pressure is not within the given limits, the springs should be adjusted by moving them into different locations or, where no adjustment is provided, the springs should be renewed.

#### (D) DYNAMO AND STARTER FIELD-COILS —TESTING

The field coils should be tested, without removing them from the carcass, by using a 12-volt battery, two test prods and a 12-volt test lamp.

**(a) Earthing Test.** Apply one prod to a field coil lead and the other prod to a suitable point on the carcass free from enamel and insulation.

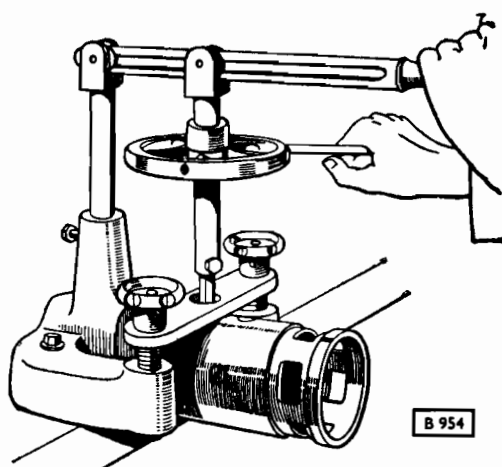


Fig. O4 Wheel-operated screwdriver for tightening pole shoe fixing screws

If the lamp lights, this is an indication that the coil insulation is faulty.

**(b) Open Circuit Test.** Apply one prod to each coil lead, baring insulation if necessary.

If the lamp fails to light, this indicates an open circuit. Unless the fault is obvious and can be rectified the coils must be renewed.

#### (c) Short Circuit Test

**(1) With dynamos only,** a rough indication of a short circuit will be given when conducting test (b) above. If the coils are sound, the lamp will **not** light to full brilliance due to the extra resistance of the coils being in circuit.

**(2) For both dynamos and starter motors** the most satisfactory way of finding an internal short circuit is by using an ohmmeter. The resistance of the coils should then be as shown in Sections 7 and 10.

#### (E) DYNAMO AND STARTER FIELD COILS —TO RENEW

The field coils must not be disturbed unless, when tested, they are found to be faulty; in this case new coils must be fitted, for which a wheel-operated screwdriver (*see Fig. O4*) is necessary to ensure that there will not be any air gap between the pole shoes and the inner face of the carcass. Should this equipment not be available, then a replacement unit should be fitted.

New field coils should be fitted over the pole shoes so that they bed down as far as possible on the pole shoe wings. Pole shoes should be fitted into the set of coils so that the field leads are at the commutator end; then fit the screws and tighten them by means of the wheel-operated screwdriver.

## (F) DYNAMO AND STARTER ARMATURES

Armatures must be removed from the carcass before testing.

Examine the armature for obvious faults such as loose connections. These should be resoldered, using rosin flux. **Never use acid flux for electrical connections.**

**NOTE.**—No attempt must be made to machine an armature core or true a distorted shaft.

(a) **Earthing Test.** Using a 12-volt battery, test prods and lamp, place one prod on the armature and the other on the commutator.

If the lamp lights, the armature is faulty and must be renewed.

(b) **Open Circuit Test.** An open circuit in the armature generally results in the commutator bars being severely burned. This is easily detected by eye.

(c) **Short Circuit Test.** Place the armature on a "growler" connected to a source of alternating current. Then, holding a hacksaw blade just above it, rotate the armature slowly.

If the saw blade vibrates or buzzes this indicates that the armature is short-circuited. In this case remove the armature and inspect the commutator for copper or brush deposits. Clean the commutator thoroughly and then repeat the test.

**Note.**—For instructions regarding the testing of the alternator see Sections 7 and 15.

## (G) MISCELLANEOUS

(a) **Terminals and Brush Boxes.** Check these for earthing, the procedure being similar to that given before. Test for short circuits between brush boxes of opposite polarity.

(b) **Ball and Roller Bearings.** Bearings must be cleaned thoroughly in petrol, dried, and inspected for signs of wear.

## Section 3 ALTERNATOR AND DYNAMO—MAINTENANCE

### (A) LUBRICATION

When lubricators are fitted they should be kept filled with **high melting point grease**, and at periods quoted on the Lubrication Chart the caps should be given **one half turn** (*see Part S*). When lubricators are not fitted the bearings should be attended to at vehicle overhaul periods as described in Section 2(G) (b) above, or alternatively, on certain units, the bearings are pre-packed

If there is any play between outer and inner races, or flat spots on the balls or rollers, a bearing must be renewed.

Before assembly, bearings should be suitably lubricated to approximately two-thirds of their capacity with **high melting point grease**. Any lubricators (when fitted) for these bearings should also be filled with the same type of lubricant.

(c) **End Frames.** These are located by either a dowel or an arrowhead stamped on the end frame and carcass. In either case accurate alignment is important.

(d) **Cables.** Inspect all cables to see that they are in good condition and renew if necessary.

See that all cables are firmly soldered into their sockets; connections often appear at first sight to be well made but, on closer examination, the cables will be found to be loose in their sockets. Make sure that the markings on the identification sleeves of the cables correspond to the markings of the terminals to which they are connected and that the connections are clean and secure.

(e) **Cleanliness.** Alternators, dynamos and starter motors should always be kept scrupulously clean, both internally and externally. Before and after assembly blow out all dust and dirt with compressed air.

### (H) DYNAMO POLARITY

Before fitting a dynamo to an engine or chassis it should be run as a motor, both as a test and also in order to provide a residual field of correct polarity in the magnetic circuit.

After ascertaining (from Section 7) to which brush(es) the field coils are connected, connect the field terminal(s) of the machine to the terminal of **opposite** polarity with a jumper lead. Connect a 24-volt battery to the dynamo with a suitable switch in circuit. On closing the switch the armature shaft should revolve in the same direction as it is designed to be driven by the engine.

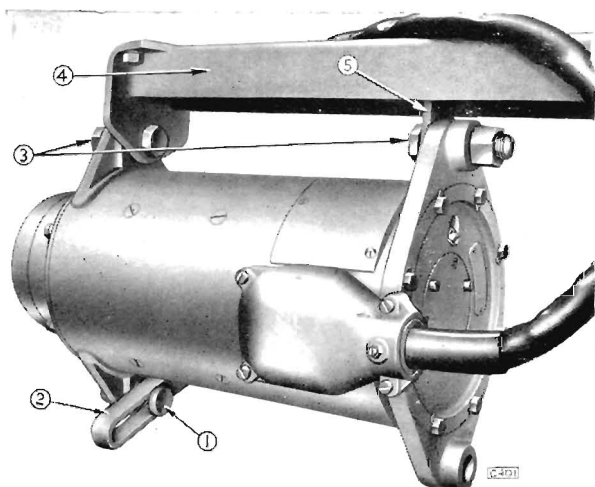
Remove the jumper lead after this test.

and sealed for the life of the unit.

### (B) DRIVE BELTS (if fitted)

At periods quoted in Part A check the tension of the drive belts. For engine-mounted dynamos, or alternators, instructions for this are given in Part B; but for frame-mounted machines the procedure is as follows (*see Fig. O5*):—

Slacken two suspension bolts (3) and tension link bolt (1) on the bottom flange.



**Key to Numbers:—**

- |                      |                    |
|----------------------|--------------------|
| 1. TENSION LINK BOLT | 4. SUPPORT BEAM    |
| 2. TENSION LINK      | 5. SUPPORT BRACKET |
| 3. SUSPENSION BOLTS  |                    |

**Fig. O5 Frame-mounted dynamo**

Swing the dynamo outwards until the correct belt tension (as given in Part A) is reached. Re-tighten all bolts securely.

### (C) ALTERNATOR SLIP RINGS AND BRUSHES

At periods quoted in Part A the slip rings and brushes should be inspected. Remove the slip ring end cover and examine the slip rings for pitting and scoring. If necessary, the slip rings should be skimmed **only** by qualified personnel trained by the makers of the alternator, and the brushes treated as instructed in Section 2(C). If the brushes are less than  $\frac{5}{16}$  in. (7.9 mm.) long, they should be renewed. Ensure that the slots in the drive end shield on the alternator are clear.

### (D) DYNAMO COMMUTATOR AND BRUSHES

At periods quoted in Part A the commutator and brushes should be inspected.

If the brushes are less than  $\frac{3}{8}$  in. (10 mm.) long they should be renewed. If the commutator is burnt or pitted the dynamo should be removed from the engine [see Part B or Section 8 (*frame mountings*)], dismantled and the commutator and brushes treated as described in Section 2 (B) and (C).

After any adjustment has been made the dynamo output should be tested as described below.

### (E) TESTING THE DYNAMO IN POSITION

(a) Where the dynamo is belt-driven see that the belts are not slipping, by checking their tension.

(b) Remove the terminal box cover and check that the cables are connected to their correct terminals. Sleeves are fitted to the ends of each cable for identification purposes.

(c) Check that these cables are connected to their correct terminals in the control unit.

(d) If the above checks disclose no error, see that all lights and accessories are switched off.

(e) Disconnect from the dynamo the three cables marked (+), (−) and (F).

(f) Ascertain the polarity of the terminal(s) marked (F) and then connect a centre-zero ammeter (range 3-0-3) between this terminal and a terminal of opposite polarity.

**Note.**—For split field dynamos with two (F) terminals a test should be made independently from each.

(g) Connect a voltmeter (range 0-30) across the (+) and (−) terminals of the dynamo.

(h) Start the engine and increase its speed until the dynamo terminal voltage is 27. Check that the field current corresponds to that given in Section 7 and take care that the dynamo does not exceed its maximum output speed (also given in Section 7).

If the voltmeter remains at zero, check the brush gear and internal connections.

A **very low reading** throughout the speed rise indicates that the field windings may be faulty. This will be confirmed by the ammeter reading—if zero, a broken connection is suggested.

(i) Remove dynamo and service according to instructions in Section 2.

(j) The test described in (d) to (h) inclusive must be carried out again, and if the voltage and current do not behave as described in (h), the complete unit must be renewed.

**Note.**—For instructions regarding the testing of the alternator see Sections 7 and 15.

## Section 4

## STARTER MOTOR—MAINTENANCE

### (A) LUBRICATION

At periods quoted on the Lubrication Chart fill the lubricator on the driving end frame with engine oil (*see Part S*).

### (B) GENERAL

At periods quoted in Part A the commutator and brushes should be inspected and, if necessary, treated according to the instructions in Section 2 (B) and (C).

### (C) TESTING IN POSITION

Check the battery to see that it is in a reasonably well charged condition (*see Section 5*).

See that all cable connections are made securely.

Push the starter button; if the starter motor does not operate, connect a suitable voltmeter, reading up to 24 volts, between the solenoid and the (—) terminals on the starter motor. Push the starter button again; if no reading is indicated on the voltmeter, look for a fault in the cables between the button and the starter, or in the windings of the solenoid switch.

Push the starter button; if the solenoid switch clicks, it indicates that this is working on the first contacts only, and full load current is

not being applied to the starter motor. A faulty armature adjustment or a worn switch trigger will cause this.

Should the starter motor crash into engagement, inspect the switch trigger and plate for wear on the step and slotted portions respectively.

Intermittent starter motor operation with the starter button held down, can be caused through second contacts on the solenoid switch being burnt or the starter motor brushes worn. Faulty connections at the starter button or the battery terminal posts or faulty inter-connectors between the batteries are also likely causes.

A worn bearing at the driving end of the starter motor will cause slow engagement and considerable loss of power due to the armature fouling on the pole shoes.

If the starter motor operates but does not turn the engine, possibly the starter motor clutch is slipping or the pinion or flywheel ring teeth are worn. If the clutch is slipping, adjust as instructed in Sections 11 and 12. The starter motor itself may have moved in its mounting away from the flywheel, or the battery may be discharged.

**Note.**—It is impracticable to attempt any adjustments to the starter motor whilst it is in position on the engine. **To Remove, see Part B**

## Section 5

## BATTERY—MAINTENANCE

At periods quoted in Part A the battery should receive attention as follows :—

### (A) LEAD ACID TYPE

Brush any dirt from the top of the battery and remove the vent plugs. **On no account bring a naked light near when the vent plugs are removed, or when the battery is being charged, as the gas given off by the electrolyte is highly inflammable.**

Check the specific gravity of the electrolyte with a hydrometer (*see Fig. O6*). The following table shows the correct specific gravity of the electrolyte for various temperatures.

If the hydrometer reading falls below the appropriate figures in column (b), the battery must be charged as soon as possible either by the normal running of the vehicle or from an independent source.

Temperature	Specific Gravity	
	(a) Battery Fully Charged	(b) When Battery Requires Charging
120° F. (48.9° C.)	1.270	1.220
100° F. (37.8° C.)	1.280	1.230
80° F. (26.7° C.)	1.285	1.235
60° F. (15.6° C.)	1.295	1.245
40° F. (4.4° C.)	1.305	1.255
20° F. (-6.7° C.)	1.310	1.260

If the level of the electrolyte is so low that a hydrometer reading cannot be taken, no attempt should be made to take a reading after adding distilled water, until the battery has been on charge for at least 30 minutes.

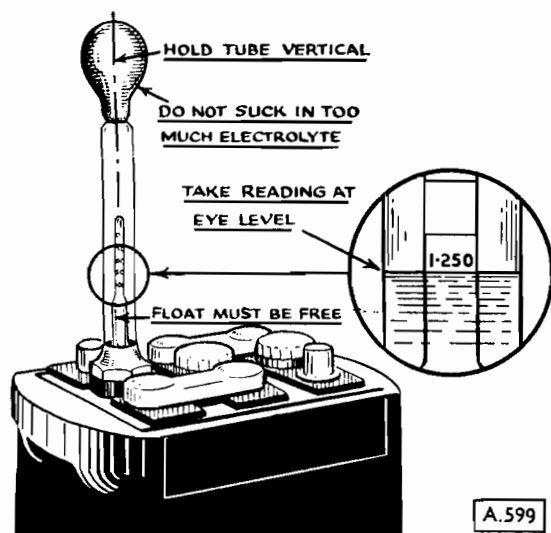


Fig. O6 Checking specific gravity of battery electrolyte

**Never** transfer the electrolyte from one cell to another.

**Never** leave a battery in a discharged condition. It must be put on charge as soon as possible.

#### (a) Electrolyte Level

The level in each cell should be  $\frac{1}{4}$  in. (6 mm.) above the top of the separator plates or level with the top of the separator guard (when fitted). **Top-up if necessary with distilled water.** Do not allow distilled water to come in contact with metal—use only a glass or earthenware container and funnel.

If an excessive amount of topping-up is required, find out the reason. The battery may be receiving an excessive charge, in which case the regulator setting should be checked (*see Section 15*). If one cell in particular needs topping-up more than another, probably the case is cracked, in which event the cell must be renewed and arrangements made to clean the container in which the battery is housed. The metal parts must be washed with a solution of ammonia or bicarbonate of soda in water. After cleaning, paint all surrounding parts, wood or metal, with anti-sulphuric paint.

#### (b) Vent Plugs

These must be clean and their air passages free.

#### (c) Cable Terminals

These must be free from corrosion, bolted tightly on the battery terminal posts and coated with petroleum jelly—**not grease**. If corrosion has taken place, disconnect the terminal from the

battery, scrape the corrosion away—taking care that none of it gets into the cells—and wipe clean with a rag moistened with weak ammonia or bicarbonate of soda solution.

### NEVER EMPTY ELECTROLYTE FROM THE BATTERY

#### (d) Charging from an Independent Source

Before starting the charge, the battery must be topped-up with distilled water to  $\frac{1}{4}$  in. (6 mm.) above the top of the separator or level with the top of the separator guard (when fitted).

Charge at the rate recommended by the battery manufacturers until the specific gravity of the electrolyte in each cell shows no rise during four hours continuous charging, and all cells “gas” freely. If the specific gravity of the electrolyte in any cell or cells fails to rise whilst on charge and “gassing” does not take place, these should be tested for an internal short circuit.

To test a cell suspected of being short-circuited, take the individual voltage of each cell, firstly whilst it is on charge, secondly whilst it is not on charge, and thirdly, if possible, whilst it is being discharged; if still fitted to the vehicle this can be done by operating the starter motor without allowing the engine to start.

In each case the voltage of a defective cell will be much less than the others and the battery or the cell should be renewed.

During charging, the temperature of the electrolyte should not exceed 120° F. (48.9° C.); if this is reached the charge must be suspended to allow the temperature to fall. If charging from an independent source at ambient temperatures above 100° F. (37.8° C.), this must be done at half the charging rate given above to avoid exceeding the maximum permissible electrolyte temperature of 120° F. (48.9° C.).

If at the end of the charge the specific gravity varies by more than 0.005 from the figures given in the table, column (a), it must be adjusted; raise by adding electrolyte, the specific gravity of which at 60° F. (15.6° C.) would be 1.350, or lower by adding distilled water. Remove any surplus electrolyte over  $\frac{1}{4}$  in. (6 mm.) above the top of the separator plates.

#### (e) Preparation of a dry charged battery for service.

Remove the seals from the vent plugs or filling holes.

Bring the battery to a temperature of 60° F.

Fill the battery with the correct specific gravity of pure dilute sulphuric acid (see table below), having a temperature of between 60° and 90° F (15°-32° C), to a level just below the filling holes.

Ambient Temperature	Specific Gravity	
	Acid for initial filling	Battery fully charged
Below 80° F. (27° C.)	1.260	1.285
Between 80° and 100° F (27°-38° C)	1.240	1.255
Above 100° F (38° C)	1.210	1.220

After allowing the battery to stand for approximately two hours the acid level will have dropped considerably; refill to a level  $\frac{1}{4}$  in. (6 mm.) above the top of the separator plates or level with the top of the separator guard (when fitted).

Charge the battery at the normal charge rate for four hours, noting that the acid temperature should not be permitted to exceed 110° F (43° C); if this occurs the charge rate should be reduced and the charging time increased proportionately, or the charge suspended.

If the dry charged "time limit" has expired, or due to poor storage conditions it is found that the battery requires a longer initial charge, the charge rate should be extended until both voltage and specific gravity in **all** cells remain constant for five successive hourly readings.

**Note.**—All cells should gas freely.

Finally adjust the specific gravity (see table above) and the level of the electrolyte.

## (B) ALKALINE TYPE

### (a) Maintenance

Owing to the all-steel construction, only simple maintenance is necessary, but **it is particularly important to pay special attention to the following simple requirements** in order to obtain the full advantage of the long life that Alkaline batteries provide.

### (b) Cleanliness

The battery must be kept clean and dry. It is important to avoid the collection of dirt around the bottoms of, or between the cells. Dust and dampness will cause current leakage which may result in serious damage to the cell container.

Any incrustation on the cells may be easily removed with warm water, after which the cells should be thoroughly dried before lightly smearing terminals, connections and cell lids with pure petroleum jelly—**not grease**.

Dirt or dust between, or below the cells can be conveniently removed by dry compressed air (where this is available) or by using a dry rag and a thin wooden stick.

Surface erosion of the cell may be treated in the following manner:—

Fit the original solid rubber plug supplied with the battery to prevent splashing or spilling; it is then unnecessary to empty out the electrolyte.

Dissolve all the protective bitumastic paint by brushing with naphtha, then thoroughly clean and dry the cell.

Clean the affected area, using a wire brush, until all signs of erosion are removed.

Give the sides and bottom of the cell three coats of bitumastic paint, allowing 12 hours for each coat to dry.

Cell containers are "LIVE," therefore, do not place tools or metal objects on the top of, or between the cells as these may result in short circuit currents which may do considerable damage.

### (c) Vibration

Occasional checks on the security of the battery crates, are advised.

Any looseness may be rectified by the suitable use of wood packing strips.

### (d) Topping-up

The cells should be examined and topped-up at regular intervals so that the level of the electrolyte is never allowed to fall lower than  $\frac{1}{4}$  in. (6 mm.) above the top of the plates.

The level of the electrolyte can easily be checked by inserting a piece of glass tubing through the filler opening until it rests on the top of the plates; then by closing the top of the tube with the finger and withdrawing the tube, the height of the electrolyte above the plates will be indicated by the amount retained in the glass tube.

**WARNING.**—Lead Battery acid or even slightly acidulated water will cause serious damage to or destroy Alkaline cells.

Distilled water for accumulators is sometimes supplied in carboys that have previously contained acid and is quite unsuitable.

On no account should hydrometers or utensils which have been used for lead acid batteries be used with Alkaline cells.

Cells should be topped-up with pure distilled water—electrolyte must not be used—to the correct level above the tops of the plates as follows :—

All C.A.V. AS types, 1 in. (25.4 mm.) above plates.

C.A.V. LAS 15 type,  $\frac{3}{4}$  in. (19-mm.) above plates.

Particular care should be taken when topping-up to see that water is not allowed to fall between the cells, on crates or tops of cells, but do not overfill.

Keep filler caps closed at all times except when actually topping-up or taking specific gravity readings.

**NEVER EXAMINE CELLS WITH AN OPEN FLAME AS THE GASES EVOLVED FROM AN ALKALINE CELL ARE EXPLOSIVE.**

#### (e) Specific Gravity

The specific gravity of an alkaline cell does not vary with the state of charge and is normally in

should be returned to a battery Service Station for the electrolyte to be renewed.

These figures are based on cells topped-up to the correct level at 68° F. (20° C.). Should cells require topping-up before readings can be taken, they must be left on charge for 30 minutes before any attempt is made to take readings.

For the correct specific gravity figures for temperatures other than 68° F. (20° C.) see table below.

#### (f) Charging from an Independent Source

Should it be necessary to charge the battery from an external source due to its becoming completely discharged, charging should preferably be done at the rates given in the table below.

A full normal charge requires seven hours at normal charge rate but higher or lower rates can be used if more convenient provided that the time of charge is adjusted accordingly.

Overcharging does not damage an alkaline cell so—if in doubt—always err on the generous side when charging.

In emergency conditions, where it is desired to recharge a battery very quickly for service reasons,

Temperature	48° F. (9° C.)	68° F. (20° C.)	88° F. (31° C.)	108° F. (42° C.)
<b>Specific Gravity :—</b>				
<b>Upper Limit</b> .. ..	1.205	1.200	1.195	1.190
	1.195	1.190	1.185	1.180
	1.185	1.180	1.175	1.170
	1.175	1.170	1.165	1.160
	1.165	1.160	1.155	1.150
<b>Lower Limit</b> .. ..	1.155	1.150	1.145	1.140

the region of 1.180 although figures of between 1.200 and 1.150 are permissible. Cells should not be operated if the specific gravity is outside these limits ; when the lower limit is exceeded, the cells

any rate up to three times the normal rate can be used for a short period, provided that the battery temperature does not exceed 110° F. (43.3° C.).

Type of Battery	Capacity at 10 Hour Rate (Amp. Hrs.)	Normal Charge Current (Amps.)
<b>C.A.V. :—</b>		
AS12 .. ..	120	24
AS14 .. ..	140	28
AS16 .. ..	160	32
AS20 .. ..	200	40
<b>LAS15</b> .. ..	155	31

## Section 6

## ELECTRIC HORN—MAINTENANCE

(see Fig. O7)

The tone of the horn cannot be altered, the only adjustment being the take up of wear on moving parts.

If the horn fails to operate satisfactorily, proceed as follows :—

Check the horn push button, auxiliaries fuse, external wiring and horn connections for faults.

Check the tightness of the horn securing bolts and those of adjacent units.

Remove the cover fixing screw from the horn and remove the cover. Detach the cover securing bracket by springing it out of its locating slots.

Slacken the lock nut, depress the horn push button and then screw the fixed contact in by means of the adjusting nut until the horn fails to sound (i.e. the contacts just open). Release the horn push button.

Screw the fixed contact out **half-a-turn** and secure it in this position with the lock nut.

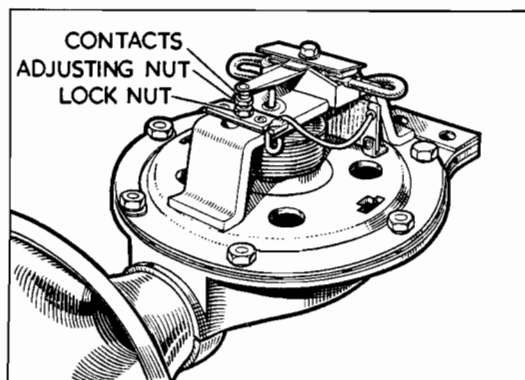


Fig. O7 Typical horn with cover removed

Replace the cover securing bracket and refit the cover.

**Note.**—On certain instruments, the cover cannot be removed, but the adjusting screw protrudes through the cover.

#### HIGH FREQUENCY TYPE

In the event of failure, the push button, external wiring and horn connections should be checked and any fault rectified. If the horn still fails to operate satisfactorily the unit should be renewed.

O12

## NOTES

FOLIO 02/22

**ALTERNATOR — C.A.V.**

(See Figs. O1 and O2)

**Section 7****OPERATION AND DATA****Operation**

The alternator is a 3-phase, fan cooled machine of various nominal diameters (see "Data") and 24 volt rating, having a revolving field and stationary armature. Operated in conjunction with a suitable control unit, the alternator provides a progressively increasing charging current up to its self-limiting output (see "Data").

Ventilation is by means of a radial fan, incorporated within the unit, cooling air being forced through the slots in the drive end shield.

When applicable, water proofing of the unit is achieved by sealing both bearings and the slip ring compartment.

Electrical connections for the field terminals, are made via a push connection plug, adjacent to the brush gear, and separately mounted positive and negative output terminals (see Fig. O2).

Alternatively, on certain types (see Fig. O1) connections are made via a multi-pin socket; a key formed in the socket housing ensures that the mating plug is fitted in one position only; a knurled nut locks the plug in position.

All cables are suitably marked for identification.

The following precautions must be strictly observed to ensure that the equipment forming the electrical system is not damaged.

(i) To avoid arcing or accidental short-circuiting, it is essential to stop the engine whenever a lead or the

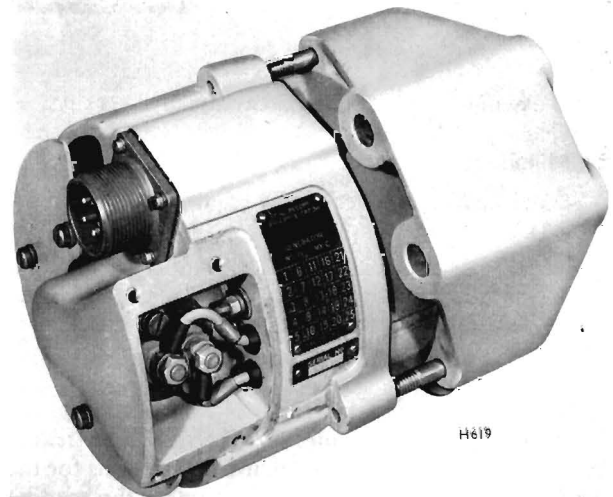


Fig. O1 Typical alternator (multi-pin connection)

multi-point plug is disconnected.

(ii) When a lead is disconnected, it must be marked, if necessary, to ensure correct re-connection, otherwise **short-circuiting** or reversed polarity, no matter how brief, will cause immediate and permanent damage to the unit.

(iii) The battery must never be disconnected whilst the engine is running.

(iv) If welding or soldering is necessary on, or in the vicinity of the alternator, precautions must be taken to ensure that heat is not transmitted to any transistor or diode, otherwise irreparable damage will be caused.

**Data**

Type	Nominal Diameter	Weight (excluding pulley)		Max Output (Hot)		Alternator r.p.m.		Brush Spring Pressure		Drive Ratio Alternator Speed: Engine Speed
		lb.	kg.	Watt	Amp.	Cut-in	max output	oz.	gm.	
AC5/24	5 in. (127 mm.)	13	5.9	853	31 @ 27.5V.	1150	4000	8	227	2.38
No. 11 MK.C	5½ in. (140 mm.)	16	7.3	784	27.5 @ 28.5V	1150	4000	5½-6½	156-184	2.42
AC724	7 in. (178 mm.)	38	17.3	1650	60 @ 24 V	580	2250	8-9	227-255	2.33
No. 10 MK.2	7 in. (178 mm.)	40	18.1	2475	90 @ 27.5V	900	4500	8-10	227-284	2.42

## Section 8

## TO DISMANTLE

It is not considered advisable to dismantle the alternator further than the removal of the cowl or multi-pin plug when cleaning the slip ring com-

partment; or the brush box when inspecting the brushes (*see Sections 2 and 3*).

## Section 9

## TO ASSEMBLE AND TEST

### To Assemble

No assembly instructions are given as it is preferable to replace a defective alternator by a new or reconditioned unit.

Should further instructions be required, apply to any AEC Depot or Agent.

Operations such as renewal of the slip rings and insulation tests should be performed only by qualified personnel trained by the makers of the alternator.

### To Test

The characteristics of the units constituting the electrical installation require that the system be treated as a whole. For this reason, testing instructions for the alternator are included in Section 15 under the heading "To Test the Charging System" etc.

**Note.**—When the alternator is supplied with an engine **only**, it will be necessary to refer to the manufacturer of the equipment, to ascertain the type of control unit being fitted in conjunction with the alternator.

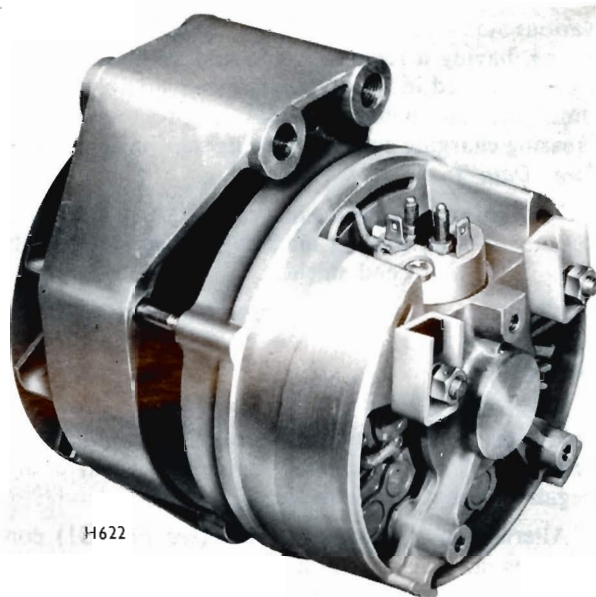


Fig. O2 Typical alternator (push plug connection)

## FOLIO 03/7

## STARTER MOTOR (C.A.V. TYPES, BS524L, M, P, SL and U624)

## Section 10

## OPERATION AND DATA

(See Fig. 01)

Each of these 24-volt starter motors is of the axial type and is provided with a built-in solenoid switch giving two stage operation. The solenoid switches vary in detail for different types of starter motor but their operation is similar in each case.

The field winding is divided into two main series field coils, two auxiliary coils, each made up of an auxiliary shunt coil, and auxiliary series coil.

The starter button, when operated, closes the first stage contacts in the solenoid switch which causes the

complete armature assembly to be drawn towards the driving end by the magnetic field and the pinion brought into mesh with the teeth on the flywheel.

As the armature nears the end of its axial travel, the second stage contacts on the solenoid switch close, completing the circuit to the main series winding and full torque is exerted on the engine.

All axial starters are fitted with an overload clutch interposed in the drive between the pinion and armature which safeguards the pinion teeth from excessive loading.

## DATA

Type	Clutch Slip Setting	Brush Spring Pressure
BS524L, BS524M and BS524P ..	80-100 lb. ft. (11.1-13.8 kg.m.)	42-53 oz. (1,190-1,502 gm.)
SL524 .. .. .	80-100 lb. ft. (11.1-13.8 kg.m.)	47-62 oz. (1,350-1,750 gm.)
U624 .. .. .	100-120 lb. ft. (13.8-16.6 kg.m.)	18-24 oz. (510-680 gm.)

## Section 11

## TO DISMANTLE AND SERVICE

(See Figs. 01 and 02)

**To Remove the Commutator End Frame Complete**

Remove the commutator end cover.

Remove the outer nut on the armature plunger.

Lift the brushes in their holders and retain them in the lifted position by the brush springs.

**Note.**—Brushes must not be removed from the holders except for removal or "bedding" purposes.

**Mark the leads to the brushes and solenoid switch so that they can be easily identified on assembly.**

Remove the screws securing the main and auxiliary field coil connections to the solenoid switch.

Remove the screw holding the main field connections to the connector at the bottom of the commutator end shield.

Remove the commutator end frame through bolts and withdraw the end frame and brush gear complete from the carcass.

**To Remove the Solenoid Switch**

Remove the commutator end cover.

Remove the screws securing the main and auxiliary field coil connections to the solenoid switch.

Remove the screws securing the (+) terminal connector.

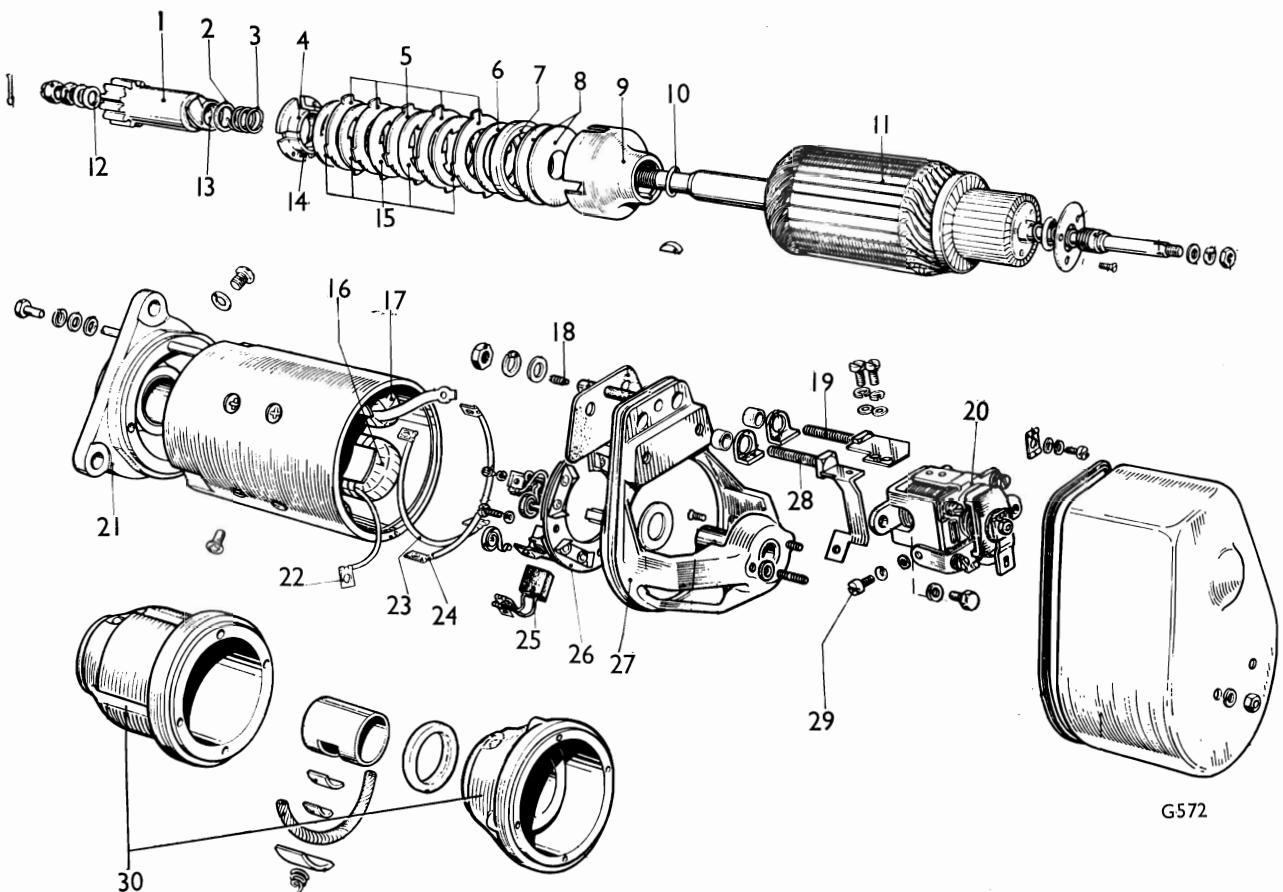
Remove the nut on the (SOL) terminal and so release the tag.

If the switch is to be removed for cleaning:—

Remove the main (—) terminal nuts and the screw securing the (—) connector to its brush holder.

Take off the solenoid fixing screws and remove the switch and (—) connector together, taking care not to break the flexible connection.

If the switch is to be completely renewed, unsolder the flexible connection.



G572

**Key to Numbers:—**

- |                            |                             |   |
|----------------------------|-----------------------------|---|
| 1. PINION                  | 11. ARMATURE ASSEMBLY       | 21. DRIVING END FRAME (FLANGE MOUNTED TYPE)             |
| 2. SHIM                    | 12. SHIM                    | 22. AUXILIARY COIL LEAD CONNECTION                      |
| 3. PINION SPRING           | 13. PINION BEARING          | 23. (—) CONNECTOR TO BRUSH GEAR                         |
| 4. SLEEVE—OVERLOAD CLUTCH  | 14. SPRING                  | 24. (+) CONNECTOR TO BRUSH GEAR                         |
| 5. BRASS PLATES—CLUTCH     | 15. STEEL PLATES—CLUTCH     | 25. BRUSH   |
| 6. SHIMS                   | 16. AUXILIARY COIL          | 26. BASE WITH BRUSH GEAR                                |
| 7. BACK PLATES             | 17. MAIN COIL               | 27. COMMUTATOR END FRAME                                |
| 8. PRESSURE PLATES         | 18. SOLENOID TERMINAL SCREW | 28. (—) CONNECTOR                                       |
| 9. HOUSING—OVERLOAD CLUTCH | 19. (+) CONNECTOR           | 29. SECURING SCREW (—) CONNECTOR                        |
| 10. SEALING RING           | 20. SOLENOID SWITCH         | 30. ALTERNATIVE DRIVING END FRAME (BARREL MOUNTED TYPE) |

**Fig. O1 Exploded view of a typical "axial" type starter****To Remove the Driving End Frame and Armature**

The driving end frame and the armature can be removed without taking off the commutator end frame as follows.

Remove the commutator end cover.

Remove the outer nut on the armature plunger.

Lift the brushes in their holders and retain them in the lifted position by the brush springs.

Remove the driving end frame through bolts, tap the end frame away from the carcass with a hide or wooden mallet, and gently slide out the armature and end frame complete.

Unscrew the armature plunger nut and remove the plunger and spring.

**To Change the Pinion**

To change the pinion without dismantling the starter motor is only possible if these instructions are followed with the greatest care:—

Remove the split pin and slotted nut from the shaft.

Stand the starter motor on end, pinion uppermost. Slacken the thin shaft nut, keep the pinion held down firmly against its spring pressure, and remove the nut and distance washers; remove the lubricating plug and spring.

Whilst still maintaining resistance against the spring, turn the pinion slowly in the **opposite direction** to the normal starter motor driving rotation, as indicated on the nameplate fixed to the driving end frame barrel, and gradually release the pressure while turning until the pinion is unscrewed from the clutch and is removable from the end frame. **It is essential that this operation is done slowly and carefully to avoid disturbing the clutch plates.**

See that the new pinion has the same part number as the old one; this will be found on the front face of the pinion.

Carefully insert the new pinion into the end frame until it meets with resistance, then turn it slowly in the normal driving direction of the starter motor rotation, until a forward movement is felt indicating that the pinion has engaged with the clutch plates.

Push the pinion into the end frame to its full extent against the spring pressure. Hold it in position and screw on the thin shaft nut with its hardened washer; tighten the nut securely. Screw on the slotted nut, tighten it and insert a split pin; then refit the spring and lubricating plug.

**If the pinion cannot be changed by the above method, it is necessary to proceed as follows:—**

Remove the armature (see *"To Remove the Driving End Frame and Armature"*).

Hold the armature securely in a vice with soft metal jaws and remove the nuts and distance washers from the pinion. Withdraw the pinion and driving end frame from the armature and detach the spring and shim.

Examine the spring for damage or loss of resiliency and renew if necessary.

Ensure that there are no burrs on the pinion thread. Test the pinion in the inner sleeve of the clutch for freedom of movement; any sticking of these parts will cause the clutch to slip.

Grease the pinion spring and bore of the pinion.

Fit the spring on the armature shaft followed by the rubber sealing ring (when fitted) and the shims.

Insert the pinion into the driving end frame taking care to lift the felt lubricating pad; slide the pinion and driving end frame on to the armature, and twist the pinion into the clutch.

Refit the shim, washer and pinion securing nuts. The pinion, when fully tightened, should be free to slide endways for approximately  $\frac{3}{32}$  in. (3 mm.).

Re-assemble the starter motor by reversing the instructions given under **"To Remove the Driving End Frame and Armature."**

### To Service the Clutch

The slip torque of the clutch should be tested as follows:—

Remove the driving end frame and armature from the carcass and clamp the armature between the soft metal jaws of a vice.

Fit a torque spanner to the teeth of the pinion so that the torque applied is in the opposite direction to normal rotation.

In proper adjustment, the clutch should slip within the range quoted under **DATA** in Section 10; should the clutch slip below the limit, this will be caused through excessive wear of the clutch and when this happens, the worn plates must be renewed.

### To Renew the Clutch Plates

Remove the pinion and driving end frame together and the pinion spring.

Withdraw the inner sleeve from the clutch housing together with the steel and brass plates; there should be five steel and five brass.

Ensure that all burrs and sharp edges are removed from the clutch parts.

Lightly grease the plates on assembly inserting them, alternatively brass and steel, into the clutch housing **beginning with a brass one**. This must be done so that the last one will be steel in order to take the pressure of the small springs.

Assemble the inner sleeve, pinion and driving end frame to the armature shaft; ensure that the inside of the pinion is filled with grease and that the springs are in position.

Refit the torque spanner to the teeth of the pinion and adjust the clutch initially to slip between 100 to 120 lb. ft. (13.8 to 16.6 kg. m.) for a 5 in. (127 mm.) dia. starter or 120 to 140 lb. ft. (16.6 to 19.3 kg. m.) for 6 in. (152 mm.) dia. starter.

Slip the clutch ten times to "bed" in the plates then finally re-adjust the clutch to slip within the range quoted under **DATA** in Section 10.

If the slip torque is below the lower limit, the clutch must be dismantled again and one or more compensating shims added between the clutch plates and back plate. The shims are made in two thicknesses, 0.004 in. and 0.006 in. (0.10 and 0.15 mm.). Adding shims will increase the slipping torque and vice versa.

### Bearings

Both armature shaft bearings, at the driving end and commutator end, are accurately machined after fixing in the end frames and should therefore only be renewed as a complete assembly with their end frames. **No attempt should be made to renew the bearings only.**

### To Service the Solenoid Switch (see Fig. O2)

Remove the switch in accordance with the instructions given under **"To Remove the Solenoid Switch from the Commutator."**

To remove the "moving" contact assembly, bend back the tabs of the lock washer and remove the

retaining nut. Detach the catch plate, being careful to retain the trigger spring; remove the plunger from the solenoid coil and dismantle the complete moving contact assembly.

Clean the switch contacts by wiping them with a rag moistened in spirit or clean with a very fine carborundum paper.

A very badly burnt or pitted contact should be renewed unless facilities are available for refacing.

It should be noted that not more than 0.020 in. (0.5 mm.) should be removed from the contact faces and that new "fixed" contacts are only supplied in an unmachined state; these contacts are to be assembled to the switch before being refaced.

The complete switch must be renewed in the event of the winding being damaged or broken.

On assembly, the solenoid plunger and leaf spring should be **lightly** smeared with petroleum jelly ensuring that no lubricant gets onto the contact faces.

Refit the return spring making sure that it locates over the lip on the periphery of the switch bore.

Fit the insulating washer followed by the adjusting washers, moving contact, spring and guide.

Inspect the bottom slot of the catch plate and shoulder of the trigger for wear and if signs of "rounding off" are evident renew both parts.

Fit the trigger spring and hold the spring in position with the trigger. Fit the solenoid plunger assembly and locate the end of the trigger in the catch plate.

#### To Adjust (see Fig. O2)

When new contacts have been fitted, the gaps should be adjusted as follows:—

Add or remove the adjusting washers under the moving contacts to give the dimension "B" and "C." The thickness of adjusting washers available are, 0.004 (0.1 mm.), 0.008 in. (0.2 mm.), 0.012 in. (0.3 mm.) and 0.040 in. (1 mm.).

When the correct number of adjusting washers have been fitted, check the gap between the catch plate and the shoulder on the trigger is within the measurement given for dimension "A."

After adjustment, tighten the securing nut and lock with the tab washer.

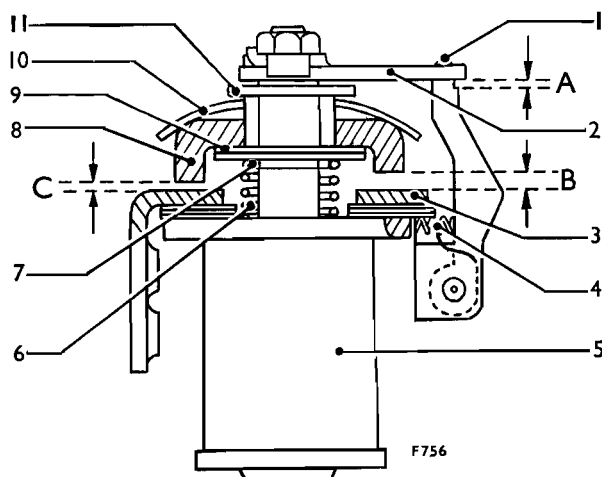
#### To Test

Before the switch is fitted to the commutator end frame the solenoid winding should be tested as follows:—

Connect the solenoid coil leads to a 24 volt battery, with a variable resistance connected as a potentiometer, and a voltmeter capable of reading from 0 to 30 volts.

With the switch plunger held in a horizontal position, apply a voltage of 15 volts; the first contacts should close. Press the trigger switch to release the catch plate and check that the second contact closes.

If this test is carried out satisfactorily, the switch can be subjected to a further test of a **few seconds duration** at twice the normal voltage to check that the catch does not trip before the trigger has been operated.



#### Key to Letters and Numbers:—

Types	
A.	BBNG = 0.079 ± 0.004 in. (2.0 ± 0.1 mm.) BBNFA = 0.083 ± 0.004 in. (2.1 ± 0.1 mm.)
B.	BBNG = 0.142 ± 0.008 in. (3.6 ± 0.2 mm.) BBNFA = 0.146 ± 0.004 in. (3.7 ± 0.1 mm.)
C.	BBNG = 0.394 ± 0.004 in. (1.0 ± 0.1 mm.) BBNFA = 0.433 ± 0.004 in. (1.1 ± 0.1 mm.)

- |                                     |                         |
|-------------------------------------|-------------------------|
| 1. TRIGGER                          | 6. COIL RETURN SPRING   |
| 2. CATCH PLATE                      | 7. INSULATING WASHERS   |
| 3. FIXED CONTACT                    | 8. MOVING CONTACT       |
| 4. TRIGGER SPRING                   | 9. ADJUSTING WASHERS    |
| 5. SOLENOID OPERATING COIL ASSEMBLY | 10. CONTACT LEAF SPRING |
|                                     | 11. CONTACT GUIDE       |

Fig. O2 Arrangement of solenoid switch

## Section 12

## TO ASSEMBLE

(See Figs. O1 and O2)

Assembly is mainly a reversal of the instructions set out in Section 11.

The following points should, however, receive special consideration:—

Fill the plunger spring cavity inside the armature

with grease and the interior of the pinion with grease.

Fill the lubricator on the driving end frame with engine oil, allowing sufficient time for the lubricating pad to absorb the oil. Wipe off any surplus oil which may have run into the inside of the driving end frame.

Fit the solenoid switch to the commutator end frame and re-connect the solenoid winding leads to their respective terminals.

Fit the commutator end frame to the carcass, ensuring that the frame is correctly located on the dowel.

Refit the main field coil ends, positive terminal connector and the auxiliary field connections to the solenoid switch.

Fit the screws and insulating pieces holding the

main field connections to the connector at the bottom of the commutator end frame.

Insert the armature and driving end frame into the carcass and locate it carefully on its bearing at the commutator end. Spin the armature to see that it is not binding and is free to rotate.

Tighten all screws holding both driving and commutator end frames.

Make sure that the flexible brush and auxiliary field leads are carried to their correct connection points on the brushgear.

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## NOTES

**NOTES**

## NOTES

FOLIO 04/29

# TRANSISTORISED REGULATOR UNIT (C.A.V. TYPE 440)

## INSTRUMENT PANEL FUSE AND DISTRIBUTION PANEL AND ISOLATING SWITCH (WHEN FITTED)

### Section 13

### OPERATION AND DATA

Control of the electrical system is effected by:—

- (i) A regulator unit which automatically regulates the electricity supply from the alternator to the battery and which in conjunction with the rectifier diodes housed in the alternator, protects the battery against reverse flow when the alternator is stationary.
- (ii) A separately mounted instrument panel containing instruments, warning lights and switches for the general electrical services operated by the driver.
- (iii) A fuse and distribution panel located in the steering column pedestal having a removable separate cover for easy access.
- (iv) An isolating switch (when fitted) for cutting off the battery from the remainder of the electrical system. Normally this switch is opened only during maintenance operations as referred to in Section 14 and in Part A.

The regulator is a fully transistorised unit with no moving parts and as the alternator is self-limiting in its current output, the regulator has only to control voltage. It is a non-repairable unit contained within a sealed aluminium case finned to assist cooling.

Three terminals, marked HI, MED or LO respectively as shown in Fig. O1, are provided to allow the appropriate voltage setting to be made to suit varying operating conditions.

Terminal selection is best ascertained by the practical experience of the operator.

For normal conditions, the MED terminal should be used. For continuous long distance operation, to prevent the batteries being overcharged, use terminal LO and for continuous short distance start and stop operation, to prevent the batteries being undercharged, use terminal HI.

If in doubt, contact any AEC Depot or Agent.

#### Key to Numbers:—

1. BATTERY NEGATIVE
  2. ALTERNATOR FIELD
  3. WARNING LIGHT (See "Note")
  4. ALTERNATOR FIELD
  5. HIGH
  6. MEDIUM
  7. LOW
- } VARIABLE VOLTAGE  
OUTPUT (POSITIVE)

**Note:**— This terminal is not in use as the warning light is connected to "A" ("A" and "WL" are linked)

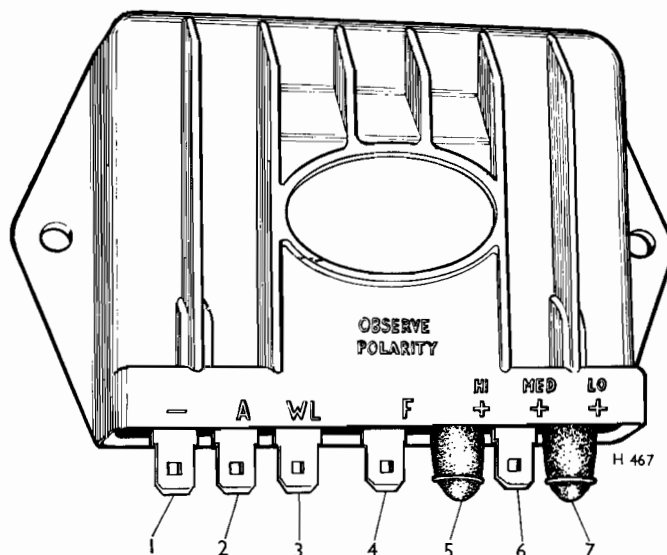


Fig. O1 Regulator unit showing terminal connections

### Instrument Panel

The **Alternator Charging Indicator Light** will illuminate immediately the "start" switch is closed and will be extinguished as soon as the engine is started. The lamp will relight when the engine is stopped or if, for any reason, the alternator ceases to charge the battery.

The **"Start Switch"** is included in the starter push button and alternator charging indicator light circuits, hence it must be closed to make these operative. In addition, the direction indicators, stop lights, heater blower, electrical speedometer and low pressure warning buzzer are included in this circuit.

The **Side and Tail Lamp Switch** also controls the head lamp and panel light circuits; the head lamps cannot be switched on while this switch remains open.

Access to the **warning and panel light** bulbs is by removing the instrument panel top cover. The warning lights are fitted with cylindrical shields, these must be refitted after bulb replacement.

### Fuse and Distribution Panel

The wire **fuses** for the lamp and auxiliary circuits are secured to removable bridges which fit into contact

clips in the panel. Spare fuse wire is wound around the fuse bridges and each fuse bridge is stamped with the appropriate rating.

All cables to the distribution panel terminals are clearly marked for identification.  
(See Part A for further particulars of lamps and fuses.)

### Isolating Switch (when fitted)

Mounted beneath the battery cradle, the isolating switch is housed within a waterproofed container, the cable entries being through tight-fitting rubber glands. Actuated by a semi-rotatable cranked lever, the two-pole switch, when open, isolates the battery from the remainder of the chassis electrical equipment.

The switch is "ON" when the operating lever is turned fully in a **clockwise** direction and "OFF" when turned fully in an **anti-clockwise** direction.

A micro-switch, actuated by a cam on the end of the main contact operating spindle, ensures that the alternator circuit is broken **before** the batteries are isolated from the remainder of the equipment.

**Note:**—This switch is **not** a circuit-breaker; therefore all other switches on the chassis should be opened before it is operated.

## Section 14

## TO REMOVE AND FIT

### To Remove

The engine must be stopped and the battery isolated before removing any of the following units from the chassis. Battery isolation is effected by operating the isolating switch (when fitted) or by disconnecting the cables from the terminal posts on the batteries and taping the cables clear.

#### Regulator Unit

Disconnect the multi-point terminal connector from the regulator.

Note the position of the lead connected to the variable output voltage terminal and disconnect.

Remove the unit from its mounting.

#### Instrument Panel

Remove the steering wheel (*see Part A*).

Drain the air pressure system (*see Part A*).

Remove the top cover from the instrument panel.

Disconnect the pipes from the air pressure, water temperature and oil pressure gauges and the trailer brake hand control (when fitted).

Remove the fuse and distribution panel cover.

Carefully note the positions of all cables connecting the distribution panel to the instrument panel and disconnect these cables from their terminals on the distribution panel.

Remove the setscrews from around the base of the instrument panel; support the instrument panel and remove the panel support from the rear of the steering column.

Lift the instrument panel complete from the pedestal and steering column.

#### Fuse and Distribution Panel

Remove the fuse and distribution panel cover.

Carefully note the terminal positions of all cables on the panel and disconnect the cables.

Remove the setscrews securing the panel inside the pedestal and lift out the panel.

#### Isolating Switch (when fitted)

Remove the cover from the base of the isolating switch, retaining the gasket.

Slacken the nuts and bolts compressing the cable entry gland rubbers.

Note the terminal positions of the cables and disconnect; withdraw the cables through the entry glands.

Remove the setbolts securing the unit under the battery carrier and remove from the chassis.

#### To Fit

Reverse the procedure for removal noting the following points:—

##### Regulator Unit

Fit the unit to its mounting, terminals facing upwards.

Ensure that the cable controlling the voltage output is connected to the correct terminal (*see Section 13*); as the field terminal is offset, the multi-point connector can only be fitted one way.

##### Instrument Panel

Check that all cables are connected and that all instruments and electrical circuits controlled from the instrument panel function correctly.

Fit the steering wheel as instructed in Part A.

#### Fuse and Distribution Panel

Check that all cables are connected and that all electrical circuits supplied by the panel function correctly.

#### Isolating Switch (when fitted)

Fit the unit to the underside of the battery cradle with the operating lever facing outwards and to the rear. Seal the securing setbolts with Loctite Grade EV.

Before connecting the cables ensure that the switch is in the "OFF" position.

Pass the cables through the entry glands and connect to their respective terminals. It should be noted that the cables are of different lengths, the longer cable being connected to the opposing end of the switch to its entry gland. Tighten the entry gland nuts and bolts to obtain a water-tight seal.

Examine the cover gasket for distortion and, if necessary, renew; fit the gasket to the switch housing and fit the cover; do not overtighten the securing bolts.

## Section 15

## TO TEST

Instructions are given in the following paragraphs for testing the electrical system installed in the vehicle. The tests enable the servicing personnel to identify which unit—the regulator unit or the alternator—is defective if the system is not functioning correctly.

**It is emphasized that all testing and fault finding must be executed only by suitably qualified personnel.**

Owing to the nature of the transistors and diodes in the regulator unit and the alternator, no adjustments are permissible, apart from the three variations in voltage output provided on the regulator unit (*see Section 13*).

#### To Test the Charging System

In addition to the precautions noted in Section 7, it is important to observe the following points during testing:—

- (i) Check with the wiring diagram that the connections to the alternator and regulator are correct; incorrect connections may cause short circuits which will cause irreparable damage.
- (ii) Do not use insulation testers on the regulator.
- (iii) Disconnect the regulator from the system prior to making insulation tests on the wiring.
- (iv) Tests on the system for earth may be made by employing a 24 volt supply, **providing a series resistance is used to limit the current to 0.5 amperes maximum.**

#### Test Equipment Required

- (i) A British Standard first grade moving coil voltmeter, 0–50 volts range.
- (ii) A British Standard first grade moving coil ammeter, 0–100 amperes range.

#### Test Procedure

**Note:**—The batteries must be in a fully charged condition.

Connect the voltmeter across the battery or regulator unit negative terminal and one of the three positive terminals on the regulator unit marked LO, MED and HI (i.e. whichever terminal is in use).

Connect the ammeter in the alternator positive line.

Close the "start" switch and observe that the alternator charging indicator light illuminates.

Switch on all vehicle lights and allow the battery to take this load for approximately ten minutes; start the engine and run it at fast idling speed. The charging indicator light will then be extinguished and the ammeter will record a charging current, varying according to the engine speed.

Momentarily increase the engine speed to maximum r.p.m., the ammeter should read approximately 30 amps. for a 5 in. (127 mm.) dia. alternator or 60 amps. for a 7 in. (178 mm.) dia. alternator.

With the alternator running at approximately half speed, switch off all vehicle lights; depending upon the variable terminal on the regulator utilised (LO, MED or HI) the **voltage** should rise to between 26 and 28 volts and then remain constant. Simultaneously, the **current** reading should fall appreciably.

Any departure from the above sequence indicates a fault either in the equipment or in the wiring. The wiring should be checked again and, if correct, the procedure under "**Fault Finding**" should be followed in order to locate the trouble.

### **Fault Finding**

If the alternator charging indicator light illuminates upon closing the "start" switch and is extinguished when idling r.p.m. is exceeded, this is in itself an indication that the system is charging.

If the indicator light does not illuminate upon closing the "start" switch, ensure that the bulb is serviceable (*see Section 13*) and replace if necessary.

Should the light remain inoperative, check the regulator by connecting the lead from the "F" terminal to the negative terminal; if the light now appears, the unit is faulty and being irreparable, should be replaced by a new unit.

If the light still does not appear, the alternator is suspect and should be exchanged for a new or re-conditioned unit.

**Note:**—The correct functioning of the warning light is only an indication that the system is charging, and in order to establish that the regulator is controlling output, it is necessary to check the system as instructed under "**Test Procedure**".

## PART Y3

# TILT CAB

### CONTENTS

	<i>Section</i>
Tilt Cab .. .. . To Remove and Fit	1
Cab Tilting Mechanism .. .. . To Dismantle and Assemble	2
Cab Locking Mechanism .. .. . To Dismantle and Assemble	3
Heater Unit .. .. . To Remove and Fit	4

**WARNING—REMOVAL OF THE TILT CAB SHOULD NOT BE UNDERTAKEN UNLESS THE TENSION ON THE TILT BEAM IS HELD BY THE SAFETY BAR LISTED IN THE MAINTENANCE EQUIPMENT.**

## Section 1

### TILT CAB

(See Figs. Y1 and Y4)

#### To Remove

Isolate the batteries by operating the isolating switch (when fitted) or by disconnecting the cables from the terminal posts on the batteries and taping the cables clear.

Drain the coolant from the cooling system by opening the drain cock adjacent to the bottom left-hand side of the radiator.

**Note.**—If anti-freeze mixture is in use, collect the coolant in suitable containers.

Open the cab doors to gain access to the setbolts securing the upper panel and grille assembly. Remove the setbolts and lift the panel **upwards** from the cab, disconnecting the cables from the direction indicators.

Disconnect the heater water hoses, the cable to the heater blower unit and the windscreen wiper compressed air supply pipe.

If released, **secure** the cab locking mechanism.

**Using the safety bar listed in the Maintenance Equipment, clamp the tilt beam to the chassis frame (see Fig. Y4).**

Remove the nuts and washers from the cab front mounting bobbins. Similarly, remove the nuts and washers from the cab rear mountings and separate the rear mounting assembly from the arch crossmember.

Open the cab doors to their **fullest** extent and secure in this position. Ensure that the seat vertical adjustment handle at the front of the driver's seat is pointing **downwards**, then unlock the seat with the lever and tilt the seat forward.

Position a suitably strengthened wooden beam (not less than 6 in. (152 mm.) wide and 3 in. (76 mm.) thick), having lifting eyes at either end, through the cab. Attach the beam to a suitable lifting tackle by means of a sling, raise and position the beam so that it rests against the cant rail as far **forward** as possible; secure the beam in this position with clamps.

**Note.**—It is essential to position the beam under the forward end of the cant rail to prevent the cab tipping when it is raised from the chassis.

Raise the cab vertically until clear of the chassis and lower on to a stand or blocks.

#### To Fit

Reverse the procedure for removal noting the following points:—

Do **not** remove the safety bar from the tilt beam before the cab is secured on its mountings.

Ensure that the cab rear mounting rubbers are fitted on both faces of the arch crossmember and that the cup washer is fitted beneath the lower mounting, cup uppermost.

When refitting the front panel and grille assembly, check that the panel is located on the mounting hooks on the front of the cab before securing with the setbolts.

Check that all cables, hoses and pipes are connected and that the direction indicators, windscreen wipers and heater function correctly.

## Section 2

### CAB TILTING MECHANISM

(See Fig. Y1)

**Note.**—Personnel are advised not to stand directly in front of the tilt beam when tension is being applied to, or relieved from, the beam in case of failure of the winch.

#### To Dismantle

Remove the cab as instructed in Section 1.

Disconnect the snap connected multi-pin plugs on the wiring looms for the horn, head and side lights and remove the lower panel and bumper assembly.

With a suitable portable winch, anchored to the front axle beam and attached to the tilt beam by means of the shackle, listed in the Maintenance Equipment, through the hole in the beam adjacent to the stay securing clip, relieve the tension from the cab lockdown hooks.

Release the cab locking mechanism.

Remove the safety bar from the tilt beam.

Operate the portable winch sufficiently to permit the withdrawal of the arch crossmember from its location on the end of the beam.

Continue operating the winch until all tension is relieved from the beam, i.e. when the beam reaches the "neutral" position.

Disconnect the winch from the beam.

Disconnect the turnbuckle trunnion from the tilt beam.

Withdraw the split pin from the turnbuckle fork end clevis pin, remove the pin and the turnbuckle assembly.

**Note.**—Unless the turnbuckle assembly is to be dismantled its setting should not be altered.

Withdraw the split pin and remove the nut and washer from the tilt beam/mounting bobbin pivot pin.

Withdraw the tilt beam from the pin.

Rotate the mounting bobbins to permit the removal of the bolt, distance piece, rubber mountings and cup washer.

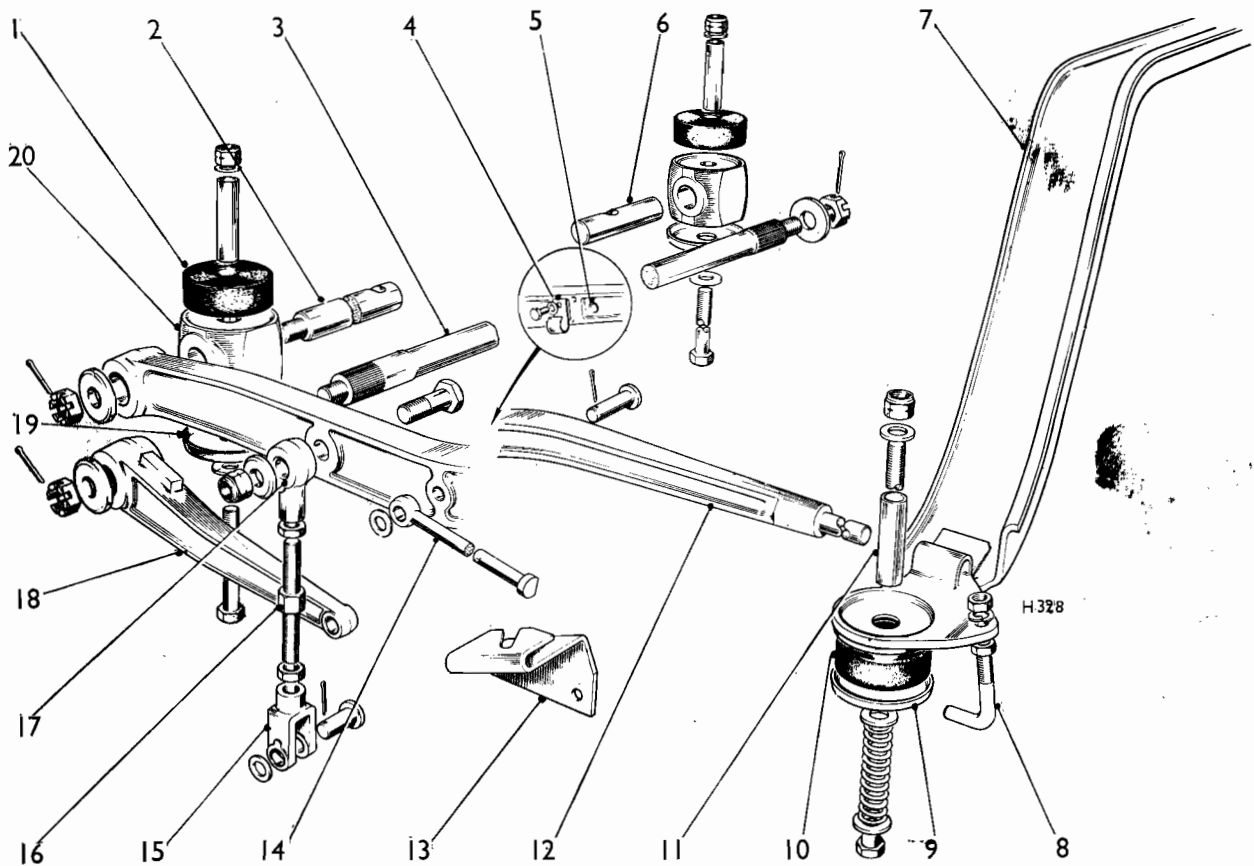
**Note.**—The mounting bolt and distance piece also locate the pivot pin in the bobbin.

Using a hammer and a suitable soft metal drift, drive the pivot pin **outwards** from the mounting bracket and remove the bobbin.

Withdraw the split pin and remove the nut and washer securing the torque reaction arm to the torsion bar.

Using a hammer and a suitable soft metal drift, drive the torque arm from the torsion bar.

Disconnect the torque reaction bracket, at the opposing end of the torsion bar, from the chassis frame and withdraw the bar complete with bracket from the chassis. If necessary, remove the bracket from the bar.



**Key to Numbers:—**

- |  |                                |                         |
|--|--------------------------------|-------------------------|
| 1. CAB UPPER MOUNTING RUBBER           | 7. ARCH CROSSMEMBER            | 14. SAFETY STAY         |
| 2. TILT BEAM/MOUNTING BOBBIN PIVOT PIN | 8. CAB LOCKDOWN HOOK           | 15. TURNBUCKLE FORK END |
| 3. TORSION BAR                         | 9. CUP WASHER                  | 16. TURNBUCKLE          |
| 4. SAFETY STAY SECURING CLIP           | 10. REAR LOWER MOUNTING RUBBER | 17. TURNBUCKLE TRUNNION |
| 5. WINCH SHACKLE PIN LOCATING HOLE     | 11. DISTANCE PIECE             | 18. TORQUE REACTION ARM |
| 6. MOUNTING BOBBIN PIVOT PIN           | 12. TILT BEAM                  | 19. CUP WASHER          |
|  | 13. SAFETY STAY BRACKET        | 20. MOUNTING BOBBIN     |

**Fig. Y1 Cab tilting mechanism.**

### To Assemble

Reverse the procedure for dismantling noting the following points:—

The threaded pivot pin is fitted to the tilt beam side of the chassis. Align the hole in the bobbin with the hole in the pin and fit the distance piece, mounting rubbers (one either side of the bobbin), cup washer and bolt. Ensure that the cup washer is fitted, cup facing upwards, beneath the lower mounting rubber. Temporarily fit the nut and washer to the mounting bolt and rotate the bobbin to the vertical position.

Similarly, fit the plain pivot pin to the opposing bobbin (locating hole offset facing inwards).

If dismantled, fit the torque reaction bracket to the **shorter** splined end of the torsion bar; enter the torsion bar through the mounting brackets and secure the reaction bracket to the frame.

Fit the tilt beam to the pivot pin, fit the washer, chamfer facing outwards, and secure the nut with a new split pin.

If removed, fit the safety stay to the outside of the beam; support the beam in the tilt position with the stay located in the stay bracket.

If dismantled, assemble the turnbuckle assembly and adjust to 7.5 in. (190.5 mm.) between the trunnion and fork end pin hole centres. **Ensure that there is an equal amount of thread visible at either end of the turnbuckle and that the fork end and trunnion are secured by sufficient threads to avoid weakening the assembly.**

**Note.**—The turnbuckle has a left-hand thread at the trunnion end and a right-hand thread at the fork end. Adjustment is effected by slackening the locknuts and rotating the turnbuckle.

Position the turnbuckle assembly on the outside of the beam, enter the pin from the inside, fit the washer, chamfer facing outwards, and secure with the special self-locking nut.

Position the torque reaction arm, lug uppermost, on the torsion bar splines so that the turnbuckle fork end pin hole is in line with the fork end. If exact alignment is not obtained the turnbuckle assembly should be adjusted **outwards**. Fit the clevis pin and washer and secure with a new split pin.

Lock the turnbuckle adjustment locknuts.

Fit the washer, chamfer facing outwards, to the torsion bar, fit and tighten the nut and secure with a new split pin.

Check that the torsion bar has a **total** end float of  $\frac{3}{32}$  in. (4 mm.) for chassis with  $\frac{5}{16}$  in. (8 mm.) thick frame or  $\frac{3}{32}$  in. (5.5 mm.) for chassis with  $\frac{1}{4}$  in. (6.4 mm.) thick frame, measured between the torque reaction arm and washer, and the torque reaction bracket and washer.

Attach the winch to the tilt beam as instructed under **"To Dismantle"** and apply tension to the beam by operating the winch. Locate the arch crossmember on the end of the beam and continue operating the winch until the arch crossmember rests on the cab support wedges.

**Operate the cab locking mechanism to the "locked" position and fit the safety bar to the beam (see Fig. Y4).**

Remove the winch from the chassis.

Fit the lower panel and bumper assembly, connecting the snap connected multi-pin plugs for the horn, head and side lights.

Fit the cab as instructed in Section 1 and check the operation of the horn, head and side lights.

## Section 3

## CAB LOCKING MECHANISM

(See Fig. Y2)

### To Dismantle

Tilt the cab (see Part A).

Disconnect the safety hook return spring and remove the split pin securing the safety hook shaft in the bracket. Withdraw the hook complete with shaft.

If necessary, remove the clamp bolt from the hook, retaining the spring tab, and press the shaft from the hook.

Remove the nuts and washers securing both operating levers on the operating shafts and, using a hammer and a suitable soft metal drift, drive the levers off the serrations and remove the operating handle and levers as a complete assembly.

If necessary, disconnect the operating handle from the levers by removing the rivets.

**Note.**—Do not alter the adjustment of the fork end unless necessary.

To remove the barrel lock, remove the grub screw located in the underside of the handle beneath the grip and withdraw the lock from the tube.

Using a hammer and a suitable soft metal tube fitted over the shaft threaded end, drive the operating shaft from the bracket and the locking hook link assembly.

**Note.**—The shaft rotates in bushes of different diameter and must, therefore, be removed from the lever side of the bracket.

If necessary, remove the spring from the link and the locking hook and, using a hammer and a suitable soft metal drift, drive the pivot pin from the link assembly.

Similarly, dismantle the opposing locking hook assembly.

### To Assemble

Reverse the procedure for dismantling noting the following points:—

Examine the operating shaft and locking hook bushes for wear and replace, if necessary.

When assembling the locking hook to the locking hook link, ensure that the pivot pin is secured at both ends by lightly peening the periphery of the pin bore in the link.

Before assembling, scribe a line between the pivot pin and operating shaft centres on the locking hook link, and similarly between the operating shaft and rivet centres on the operating lever (*see Fig. Y3*).

Position the locking hook link and locking hook assembly between its mounting brackets and enter the shaft, longer serrations first, through the larger bearing; locate the link on the serrations and drive the shaft home. Fit the nut and washer.

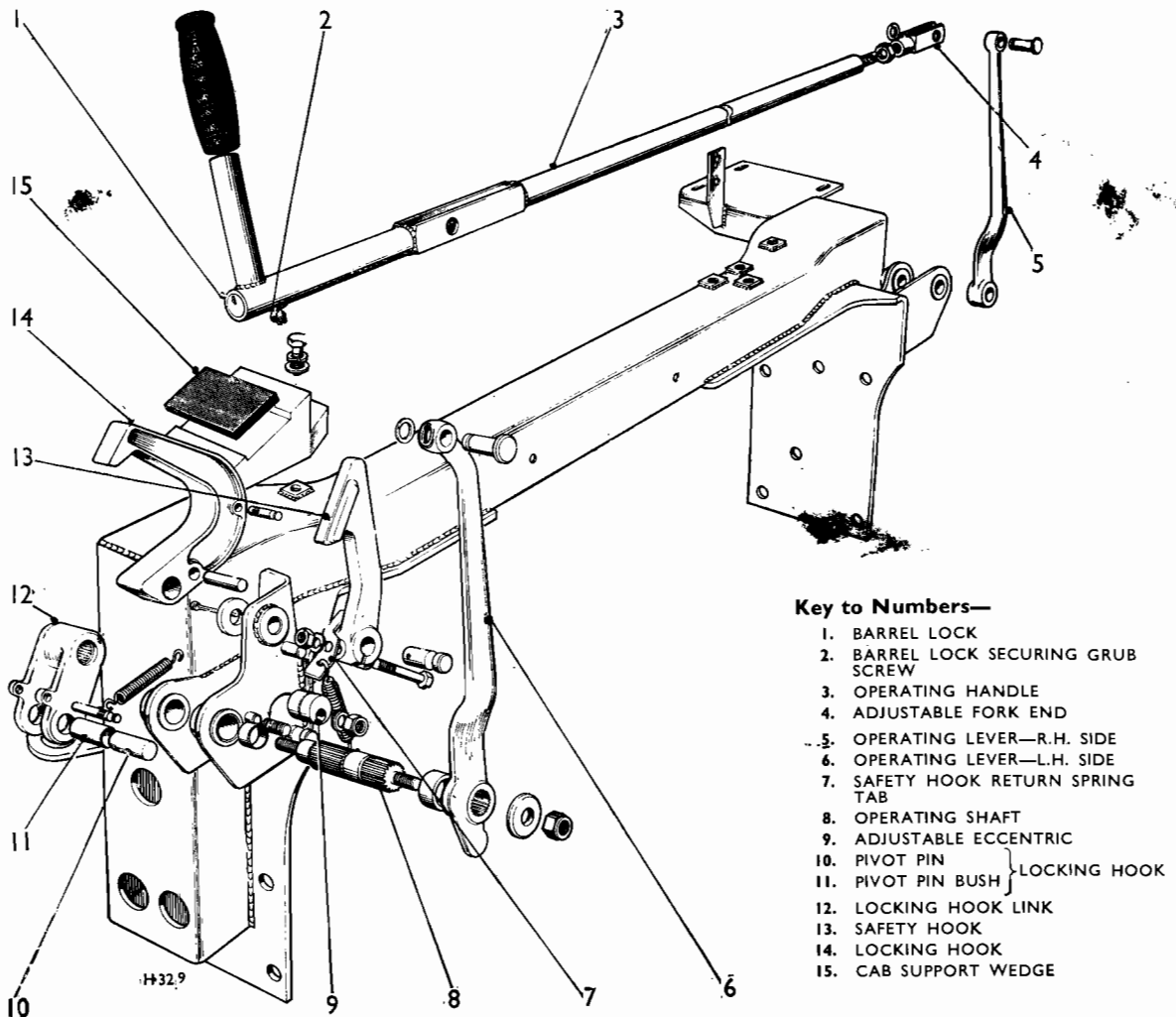
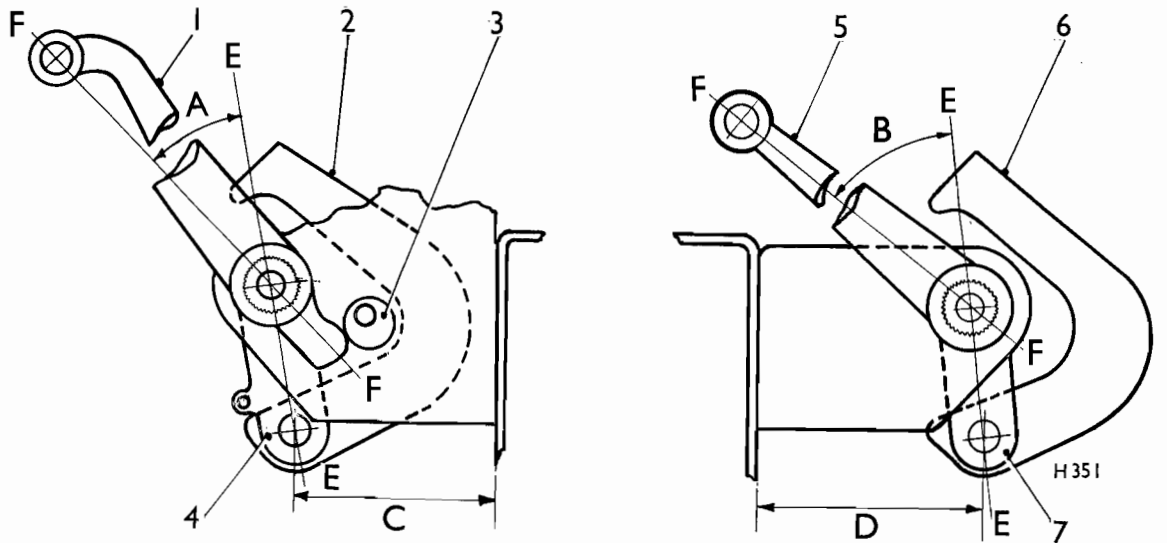


Fig. Y2 Cab locking mechanism.



#### Key to Letters and Numbers:—

A. ANGLE  $36\frac{1}{2}^\circ$  or  $(29^\circ)^*$

B. ANGLE  $51\frac{1}{2}^\circ$  or  $(29^\circ)^*$

C. DIMENSION  $3\frac{7}{8}$  in. (90.5 mm) or  $[3\frac{7}{8}$  in. to  $3\frac{9}{16}$  in. (81 mm to 84 mm)\*]

D. DIMENSION  $4\frac{7}{8}$  in. (103.2 mm) or  $[4\frac{7}{8}$  in. to  $4\frac{1}{2}$  in. (110 mm to 113 mm)\*]

EE. CENTRE LINE—LOCKING HOOK LINK

FF. CENTRE LINE—OPERATING LEVER

I. OPERATING LEVER

2. LOCKING HOOK

3. ADJUSTABLE ECCENTRIC

4. LOCKING HOOK LINK } L.H. SIDE

5. OPERATING LEVER

6. LOCKING HOOK

7. LOCKING HOOK LINK } R.H. SIDE

Fig. Y3 Setting dimensions for cab locking mechanism.

**Note:**—Angles and dimensions marked thus\* apply only to vehicles fitted with a modified cab lockdown mechanism, which is identifiable by a striking lug clamped to the operating handle, a safety hook stop plate welded to the crossmember and a washer welded on the end of both lockdown hooks.

Assemble the operating lever on the serrated end of the shaft to give angle "A" for the lever fitted to the tilt beam side of the assembly, and angle "B" for the lever fitted to the opposing side, measured between the scribed centres on the locking hook link and the operating lever (see Fig. Y3).

**Note.**—One serration is equal to  $7\frac{1}{2}^\circ$  between the lever and link centre lines.

Adjust the eccentric against the operating lever until the dimension "C" is obtained, measured between the centre of the locking hook pivot pin and the **outside** face of the crossmember (see Fig. Y3).

Similarly, position the opposing lever to give the dimension "D", measured between the centre of the locking hook pivot pin and the **outside** face of the crossmember (see Fig. Y3).

If dismantled, adjust the fork end on the operating handle until the rivets can be inserted without disturbing dimensions "C" and "D"; a nominal dimension of 41 in. (1041 mm.) or  $[42\frac{1}{2}$  in. (1080 mm.)\*], measured between the rivet centres should be obtained when the handle is assembled on the lever.

If removed, the cab lockdown hooks must be fitted

to the arch crossmember, hook pointing towards the front of the chassis, with approximately an equal amount of thread above and below the mounting lug.

Before peening over the rivets check that the mechanism operates correctly and, if necessary, adjust the cab lockdown hooks so that the arch crossmember is held under tension on the support wedges.

Ensure that the safety hook return spring tab is fitted as illustrated in Fig. Y2.

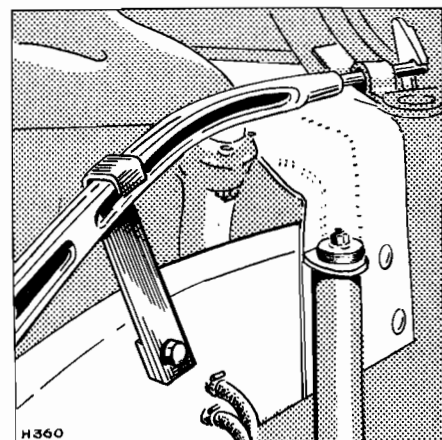


Fig. Y4 Location of safety bar on tilt beam.

Check that the striking lug on the operating handle releases the safety hook and that the hook is held under spring tension when in the "safe" position with the mechanism locked.

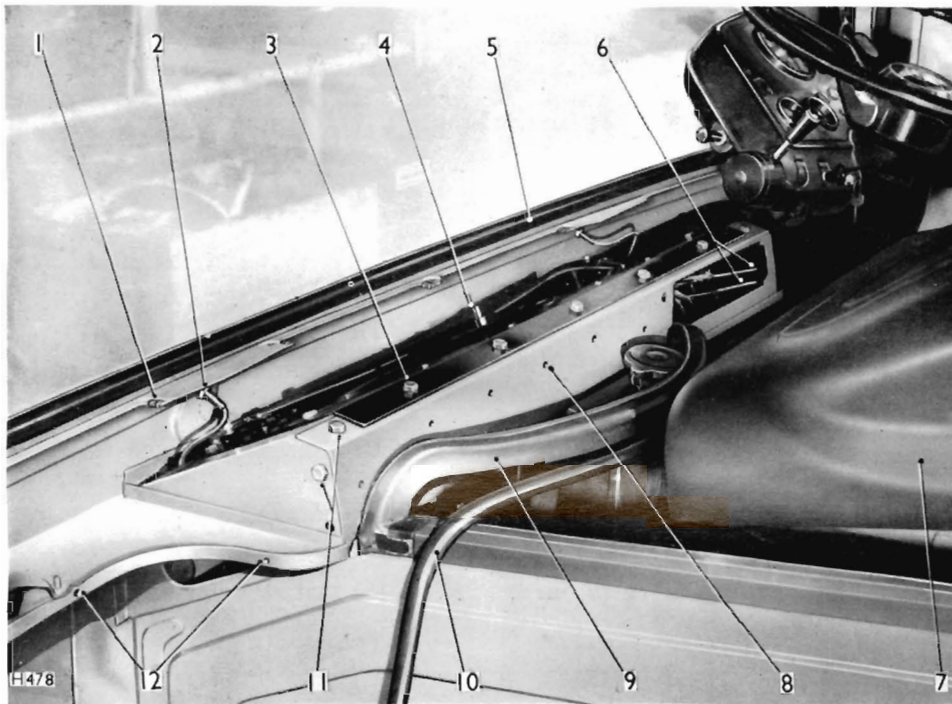
**Vehicles with modified cab lockdown mechanism** (see "Note" under Fig. Y3).

If removed, the safety hook striking lug should be

clamped to the operating handle with the lug facing towards the cab and with a nominal dimension of  $10\frac{9}{16}$  in. (268 mm.) measured between the L.H. side operating lever rivet and the striking lug clamp bolt centres. Ensure that the lug returns the safety hook to the "safe" position when the mechanism is locked.

## Section 4

## HEATER UNIT



### Key to Numbers:—

- |  |  |
|--|--|
| 1. CAPTIVE CLIP—DEMISTER NOZZLE SECURING SCREW | 8. SETSCREW HOLES—ENGINE COVER HINGE END       |
| 2. SCREENWASHER JET                            | 9. SEALING STRIP—ENGINE COVER HINGE            |
| 3. SETSCREW—HEATER TOP COVER PLATE             | 10. SEALING STRIP—FACIA PANEL                  |
| 4. HEATER FAN SPINDLE                          | 11. SETSCREW—ENGINE COVER HINGE MOUNTING PLATE |
| 5. WINDSCREEN GLAZING RUBBER                   | 12. FIXING SCREW HOLES—FACIA PANEL             |
| 6. HEATER CONTROLS                             |  |
| 7. ENGINE COVER                                |  |

Fig. Y5 Cab heater unit and controls housing (facia panel removed)

### To Remove

#### Heater hoses

Drain the cooling system (see Section 1).

Tilt the cab and disconnect the hoses where they enter the heater unit bottom plate by loosening the hose clips and sliding back the hoses to uncover the pipe joint.

#### Demister nozzles

Remove the screws from the demister nozzles on top of the facia panel; remove the nozzles and stow in a safe place. Also remove the screws at either end of the facia panel around the rubber ducting to the quarter light demister nozzles.

### Heater control panel

Detach the knobs from the heater temperature and booster controls by removing the retaining screws and sliding off the knobs.

Unscrew the knob from the screenwasher control and remove the control fixing nut by holding the screenwasher pump from inside the recirculation vent and unscrewing the nut.

Remove the control panel, using a screwdriver to ease it off the spring clips on the inside of the panel.

### Engine cover

Lift the engine cover, pull back the rubber sealing strip from the channel at the hinge end of the cover and remove the screws which secure the bonnet hinge to the fascia panel. Move the cover back out of the way of its pivoted stay. If necessary, disconnect the stay and remove the engine cover completely.

### Facia panel

Remove the fixing screws from under the rubber sealing strip along the lower edge of the fascia panel. **On late vehicles these screws have been omitted.** Remove the fascia panel by releasing the top flange from the windscreen glazing rubber and the bottom flange from the rubber sealing strip.

### Heater unit

Remove the setscrews on the underside of the heater body which hold the engine cover hinge

mounting plate.

The cab may now be locked to the normal driving position.

Unscrew the nuts on the screenwasher jets to the ends of their thread and push the jets forward to allow removal of the heater body.

Disconnect the hose pipes from the top of the screenwasher bottle and at the splitter junction on the delivery side of the screenwasher pump.

Remove the pipes from the clips on the heater body and remove the pump complete ... pipes.

Remove the setscrews from the heater top cover plate and from each end of the engine cover hinge mounting plate. Withdraw the mounting plate and lift out the heater unit for inspection.

If renewal is deemed necessary, disconnect the cables to the heater motor and remove the unit complete.

### To Fit

Reverse the procedure for removal noting the following:—

When fitting the fascia panel, it is advisable to fit the rubber sealing strip to the bottom of the panel before attempting to position the panel on the cab structure.

Check that all water hoses are in good condition.

**PART Z 26A****MAINTENANCE EQUIPMENT**

**SUITABLE FOR MEDIUM WEIGHT "TILT CAB" GOODS  
AND "RANGER" PASSENGER CHASSIS TYPES:-**

								<i>Indicated by Letter</i>
MERCURY	...	...	...	...	...	...	...	A
MARSHAL	...	...	...	...	...	...	...	B
RANGER (4M4R)	...	...	...	...	...	...	...	C

Throughout this book, reference has been made to use of special tools "listed in the Maintenance Manual." These tools have been designed by AEC to assist those responsible to reach a high level of efficiency in the maintenance and

recon.

Many of the tools can be made by workshop personnel and to facilitate this, drawings of any of the items will be requested.

Part No.	Description	The indicator letters listed against the tools should be read in conjunction with P. 71
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### ENGINE (471 or 505)

352-2729	Keys—Cylinder head, connecting rod, injector and sump nuts .. .. .	} ALL TYPES
352-2832	Tool—Cylinder liner removal and fitting .. .. .	
352-2835	Collar Set—(116 mm. bore) } Used with 352-2832	
352-2836	Collar Set—(112 mm. bore) }	
352-2821	Tool—(116 mm. bore) } Fitting piston .. .. .	
352-2454	Tool—(112 mm. bore) }	
351-79	Pliers—Gudgeon pin circlip .. .. .	
352-504	Tool—Valve spring compressing .. .. .	
352-2743	Adaptor—Used with 352-504 .. .. .	
351-93	Tool—Valve grinding .. .. .	
671-6	Tool (Standard $\frac{3}{4}$ in. B.S.P. Tap)—Removing injector sheath .. .. .	
MT5121	Tool—Fitting injector sheath .. .. .	
352-2779	Kit—Injector cleaning tools .. .. .	
352-526	Withdrawal tool—Water pump pulley .. .. .	
352-2783	Tool—Timing "Distributor" type fuel-injection pump .. .. .	
352-2850	Withdrawal tool—Water pump impellor .. .. .	
352-533	Withdrawal tool—Thermostat element .. .. .	
352-2851	Withdrawal tool—Crankshaft pulley .. .. .	
369-186	Socket Spanner—Crankshaft pulley nut .. .. .	
369-281	Socket Spanner—Idler gear locking bolts .. .. .	
MT5582	Jig—Tightening oil pump wheel .. .. .	
352-2676	Withdrawal tool—Compressor gear and housing .. .. .	} A, B, C,
352-2208	Withdrawal tool—Compressor delivery valve seat and sleeve .. .. .	
352-2644	Shackle—Lifting device .. .. .	
A410-5A	Tool—Fitting camshaft rear bearing cup plug .. .. .	
A410-5B	Tool—Fitting camshaft rear bearing cup plug .. .. .	
352-2643	Key—Fuel pump coupling (when applicable) .. .. .	

### CLUTCH

352-2862	Mandrel—Friction plate alignment	} A, B, C,
352-2831	Positioning collar— Used with 352-2862 for adjusting release levers .. .. .	
352-2670	Tool—Pressure plate compressing and release lever setting gauge .. .. .	

## GEARBOX

352-2791	Withdrawal tool—Primary shaft pilot bearing ..	} A, B, C
	Withdrawal tool—Mainshaft rear bearing ..	
	Withdrawal tool—Layshaft front bearing ..	
	Withdrawal tool—Layshaft rear bearing ..	
352-2796	Withdrawal tool—Reverse and idler gear shaft ..	
352-2799	Separating ring—Speedometer gear and 6th speed pinion—Used with 352-2797 ..	
—	Allen key $\frac{3}{8}$ in. (22.2 mm.) A/F—Drain Plugs ..	

## PROPELLER SHAFTS

352-2682	Withdrawal tool—Propeller shaft intermediate bearing .. .. .	WHEN FITTED
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## REAR AXLES

369-113	Box spanner—Coupling flange nut 1.860 in. (47.25 mm.) A/F .. .. .	} B
	Output flange, leading driving axle ..	
	Input flange, rear driving axle ..	
369-194	Spanner—Input coupling flange nut 2.410 in. (61.2 mm.) A/F, leading or driving axle ..	} ALL TYPES
369-192	Spanner—Rear hub nut .. .. .	
369-162	Key—Drain plug, $\frac{1}{2}$ in. (13 mm.) square ..	
352-2664	Withdrawal tool—Rear hub .. .. .	
352-2685	Dolly—Rear hub oil seal .. .. .	
352-2678	Die nut—Axle tube thread R.H. .. .. .	
352-2710	Die nut—Axle tube thread L.H. .. .. .	
†352-2668	Withdrawal tool—Differential bearing .. .. .	
†352-2679	Withdrawal tool—Bevel pinion bearing .. .. .	
†352-2686	Gauge ring—Differential assembly .. .. .	
†352-2662	Tommy bar—Adjusting differential bearing nuts ..	
†352-2732	Lifter—Differential assembly .. .. .	
†352-2802	Bevel pinion setting block .. .. .	
†352-2683	Gauge—Bevel pinion adjustment .. .. .	
†352-2827	Bevel pinion setting block (for axle with lockable 3rd differential) .. .. .	} A, C
*369-163	Ring spanner—Bevel wheel and double helical pinion nuts .. .. .	
*352-438	Extractor—Bevel wheel .. .. .	} ALL TYPES
*352-374	Setscrew— $1\frac{1}{4}$ in. B.S.F. used with 352-438 ..	
*352-2693	Gauge—Bevel pinion adjustment .. .. .	

† For use with single reduction axle.

\* For use with double reduction axle.

Part No.

Description

Sec Page Z1

FRONT AXLE

352-2839

Withdrawal tool—Front hub .. .. .

352-2681

Withdrawal tool—Front hub .. .. .

352-2661

Withdrawal tool—Swivel pin .. .. .

MT4370

Gauge—Front hub bearing adjustment .. ..

352-2877

Reamer—Swivel Pin Bushes (Not pre-finished type)

352-2878

Reamer—Swivel Pin Bushes .. .. .

A—Tractor and Tipper, C

A, B—Load Carriers

A—Tractor and Tipper, C

A and B

BRAKES

352-2823

Extractor—Brake shoe spring .. .. .

352-2824

Keeper—Adjuster and Expander tappets .. ..

STEERING

369-175

Box spanner—Drop arm nut .. .. .

352-2129

Withdrawal tool—Drop arm .. .. .

369-380

Spanner—Steering shaft adjustable bearing race ..

ALL TYPES

SUSPENSION

352-2840

Assembly tool—Spring and Shackle pins—Front ..

352-2860

Assembly tool—Spring and Shackle pins—Rear ..

352-2860

Assembly tool—Spring and Shackle pins—Front and Rear .. .. .

352-2860

Assembly tool—Spring pins—Front and Shackle pins—Rear .. .. .

352-2846

Assembly tool—Spring pins—Rear .. ..

352-2852

Withdrawal tool { Spring pins—Front and Rear ..

Spring pins—Front .. ..

Shackle pins .. .. .

352-2660

Assembly tool—Spring pins—Rear .. ..

352-2167

Withdrawal tool—Spring pins—Rear .. ..

352-2659

Adaptor—Used with 352-2167 .. .. .

A—Tractor, C

A—Load carrier

B

A, B

C—16 ft 6 in. (5029 mm.) wheelbase chassis only

ALL TYPES

C—16 ft 6 in. (5029 mm.) wheelbase chassis only

TILT CAB

352-2857

Safety bar—Tilt beam .. .. .

352-2843

Shackle—Tilt beam removal and assembly ..

352-2812

Box spanner .. ..

352-2875

Box spanner extension } Tilt lockdown .. ..

A, B

GENERAL

352-2814

Withdrawal wedge—Track rod and steering gear ball studs .. .. .

352-2797

Withdrawal tool—Adjustable for general use ..

352-429

Withdrawal tool—Universal—Coupling flanges ..

352-374

Setscrew—1½ in. B.S.F. used with 352-429 ..

352-2156

Priming plate—Clayton Dewandre automatic lubricator (when fitted) .. .. .

ALL TYPES

